Section 1
Introduction

Document Purpose

This document serves as a Floodway Management Plan (FMP) for the reach of the Sacramento River extending downstream from the Fremont Weir to Courtland (see Figure 1). Preparation of the FMP was the objective of a Memorandum of Understanding (MOU) executed by and among the California Reclamation Board (Reclamation Board), the Sacramento Area Flood Control Agency (SAFCA), the City of Sacramento, the City of West Sacramento, Yolo County, Sacramento County, and Sutter County in July 2002. The Flood Management Division of the California Department of Water Resources (DWR) also played a key role in supporting this development.

The MOU states, "At a minimum, the FMP is to identify goals and policies for sound floodplain management, flood conveyance, erosion control, levee stability, and levee maintenance, including guidelines for riparian habitat, public recreation, and riverfront development as floodway encroachments."

The Sacramento River Corridor Planning Forum (Forum) was created under this MOU as a collaborative group to ensure that the full range of public, agency, and expert opinion could be involved in development of the FMP. The Convening Report of the Forum identified several key purposes to be pursued in the work leading to creation of the FMP. These purposes are to:

1. achieve greater certainty and predictability in the permitting process relating to encroachments in the flood control system by recommending broadly accepted decision criteria, including guidelines for habitat restoration, public recreation, and levee protection;
2. provide an informal setting, including all significant interests, for discussion of proposed encroachments in the floodway;
3. create better understanding of the existing flood management system, the laws and policies governing the system, and its capability to provide long-term flood protection to withstand the stress of existing and potential new encroachments;
4. project future scenarios of potential floodway encroachments and land uses in order to analyze cumulative impacts and clarify the roles of land use and public safety in future visions of the corridor;

5. explore in a comprehensive and balanced manner various opportunities for enhancing system functionality in a manner that will maintain or improve existing flood control levels;
6. improve transparency, communication, and coordination of the land use and permitting process on the river;
7. explore opportunities to expand riparian habitat restoration and enhancement generally in the permitting of floodway encroachments.
8. enhance the economic feasibility of agriculture and the open space it protects, which is enjoyed by the traveling urban population; and
9. mediate local visions with regional and statewide needs to coordinate resources and liabilities.

To achieve these purposes, the MOU agencies invited 45 organizations to send representatives to the Sacramento River Corridor Planning Forum to help undertake this work. The full range of interests and public agencies concerned with the corridor gathered for an initial meeting in August 2002. Attending were representatives of the convening agencies, the U.S. Army Corps of Engineers (Corps), National Marine Fisheries Service (NOAA Fisheries), U.S. Fish and Wildlife Service (USFWS), California Department of Fish and Game, State Lands Commission, numerous local flood control and reclamation districts, neighborhood organizations, community and environmental groups, recreational and bicycle advocates, riverfront developers and property owners, chamber of commerce representatives, and county and city staff.

As the Forum began its work, the cities of Sacramento and West Sacramento also were beginning a planning process to update their Joint Riverfront Master Plan. The preparation of this new Sacramento Riverfront Master Plan (SRMP) provided an initial focus for the development of Forum goals, policies, and guidelines affecting the approximately 3.5-mile reach of the Sacramento River corridor between the mouth of the American River and the mouth of the Sacramento River Deepwater Ship Channel and Miller Park (see Figure 1). This reach supports a high intensity of existing and planned development compared to the upstream and downstream reaches within the Forum study area and thus provided a useful starting point for developing the FMP. With the aid of technical consultants, the Forum members met during 2003 in several joint working group sessions to consider the proposed features of the SRMP; discuss the impacts of the plan on flood management, ecosystem restoration, public access, recreation, and other values; and develop informal guidelines for implementing the SRMP features in a manner that, at a minimum, will not injure or interfere with the flood control system in the area and will cumulatively improve the reliability and operability of the system. That work made up Phase 1 of the Forum process and concluded with consensus adoption of guidelines in a final revised form in November 2003.

As a part of this process, SAFCA conducted an initial evaluation of the effects of SRMP features on floodway capacity using a one-dimensional hydraulic model of the existing flood control system. While the results required peer review, the evaluation indicated that the cumulative effects of the SRMP facilities would be

minimal because of the relative magnitude of change in basic hydraulic parameters associated with the facilities.

In Phase 2 during 2004–2005, the Forum considered how to address the upstream and downstream reaches of the corridor. The group determined that a starting point for this phase would be to select from the SRMP guidelines those elements that apply broadly to the Sacramento River Flood Control Project (SRFCP) area and that are consistent with the Reclamation Board's current standards as reflected in Title 23. The technical consultants convened several fact-finding panels to draw on the expertise of Forum members and other experts to define specific issues and potential solutions in the critical areas of: levee and bank condition, habitat conservation, riverfront development, public access, and land use. Following the experience of developing the Phase 1 guidelines, a clear process and format emerged for documenting each step of the formulation of proposals. Summaries of and figures resulting from each fact-finding panel can be found in Appendix A of this document.

Each fact-finding panel discussion was captured in a summary table that identified each *existing condition*, defined the *management need* associated with that condition, and offered suggestions for the potential *role of a guideline*. These elements were then discussed in a joint working group session of the full Forum where ideas for possible guidelines emerged. These ideas were then summarized in a fourth column added to the table for review at a later Forum meeting. By this iterative process, consensus was gradually built around the guidelines.

The hydraulic modeling process used in Phase 1 was adapted to deal with scenarios for the entire 50-mile reach during Phase 2 and was critiqued by engineering staff of the Corps and DWR. The modeling captured cumulative hydraulic impacts of a high level of future development under both the 1997 flood conditions and under a hypothetical "maximum flood event."

The combination of the guidelines and the analytical modeling tool is intended to provide for the first time a common set of standards to be applied by land use planning as well as floodway regulatory agencies in reviewing proposed new encroachments of all kinds in this reach of the Sacramento River Corridor in fulfillment of the MOU that established the Forum.

The Forum itself has no formal decision-making authority. The informal guidelines proposed herein for consideration by the convening agencies (the signatories to the MOU) and other participants in the Forum process do not alter current law, regulations, or land use designations but do reflect a common understanding by those agencies of a set of principles that would help create greater certainty for all interests attempting to introduce changes into the floodway, whether for economic development, public access and recreation, or ecosystem restoration.

Document Organization

Section 2 of this document summarizes the physical conditions and problems of the Sacramento River Corridor that the Forum has attempted to deal with over the past 3 years.

Section 3 presents the guidelines developed by the Forum to reduce uncertainties associated with all forms of encroachments in the floodway of the Sacramento River Corridor from Fremont Weir to the town of Courtland, or from River Mile 84 to River Mile 34. This section now incorporates into an integrated whole what were referred to during the drafting process as Phase 1 and Phase 2 guidelines and includes clear indication of which provisions apply uniquely to the 3.5-mile reach of the river covered by the SRMP, the most intensively developed portion of the study area (see Figure 1).

Section 4 presents recommendations for action and implementation steps that exemplify specific ways in which these informal guidelines could be incorporated into the formal processes and procedures of the planning and regulatory agencies of the relevant local and state agencies.

Appendices contain various figures and products developed during Forum deliberations. They include:

- Appendix A, "Fact-Finding Panel Results:"
  - Levee and Bank Conditions Fact-Finding Panel Summary
  - Habitat Conservation Fact-Finding Panel Summary
  - Land Use Fact-Finding Panel Summary and Resulting Anticipated Development Figure
  - Public Access Fact-Finding Panel Summary
  - Riverfront Development Fact-Finding Panel Summary
  - Levee Protection Zone Workshop Summary
- Appendix B, Placeholder—*blank at this time*
- Appendix C, "Bank Vegetation Treatment Figures;"
- Appendix D, "Sacramento River Permit Table;" and
- Appendix E, "Hydraulic Impact Analysis of Cumulative Development in Sacramento River Corridor Floodway."

Section 2

Sacramento River Corridor Conditions

Introduction

This section of the report summarizes the Forum effort to gather information about the current and potential future conditions and issues facing the full range of management professionals: flood control officials, habitat conservation experts and resource agencies, economic development specialists, transportation planners and advocates, land use planners, private developers, farmers, and recreation and parks planners. Staff organized a series of fact-finding panels involving these well-informed members of the Forum and others to provide information from their immediate experiences and prior technical studies that could anchor the development of guidelines in the most urgent problems. Summaries from the fact-finding panels and research can be found in Appendix A of this document. Figure 2 describes the location of features within the jurisdictional floodway and levee system, and assigns terminology used throughout the FMP, and Figure 3 summarizes the important floodway issues identified through these fact-finding panels.

The Forum turned to many other sources of information. Growth in the study area is controlled by the cities and counties using their existing land use authority. While the Forum was not conceived as a land use planning group, its members needed to develop an understanding of existing and future land uses in the area. They obtained this through review of existing land use plans (e.g., general plans, specific plans, planned projects within unincorporated towns along the river), various planning processes (SRMP, Sacramento Area Council of Governments [SACOG] Blueprint), and interaction with agency planning staff. That information was applied to the formulation of many of the guidelines.

This understanding of the future template of the study area has enabled the Forum and its technical work groups to evaluate at a hypothetical level how the physical features and increased usage in and around the river corridor may affect the floodway. A comparison of existing to hypothetical future floodway and levee conditions enabled the Forum to develop implementation guidelines that would constructively influence implementation of future projects in the river corridor to ensure that future projects complement and enhance floodway operation and maintenance.

The reach of the Sacramento River from Fremont Weir to the town of Courtland (approximately 50 river miles) runs from just below the confluence with the

Feather River through the Sacramento metropolitan region and into the northern portion of the Delta through valuable agricultural areas and past small riverside towns. It comprises a critical segment of the Sacramento River Flood Control Project where the combined floodflows of the Yuba, Bear, Feather, and upper Sacramento Rivers converge just north of the metropolitan area. Those waters surge partly over the Fremont Weir into the Yolo Bypass and partly along the mainstem Sacramento to join the inflow from the American River past the downtown area and its protected floodplain. The Bypass disperses the massive floodflows across open land; from there the floodwaters eventually reach the Delta near Rio Vista and the Bay. But as waters flow together from the American and the Sacramento Rivers in Yolo County and Sacramento County, a surging mass of flood water mounds between the narrow banks of the leveed river, pushing the water surface to a level 25 feet or more above its usual height, and then forces a portion of that flow upstream a short distance into the passage opened by the Sacramento Weir, a critical escape route that also feeds water into the Yolo Bypass and safely around the City of West Sacramento.

In the two major floods in the past 20 years, the levee system was heavily stressed, and flood fights were required in many areas to prevent catastrophe from incipient local levee failures. Although the levees did not collapse and were not overtopped in this particular reach—attributable in large part to the presence of the bypass flood-relief system—these recent floods brought to the forefront a realization of the great danger to metropolitan areas, rural communities and residences, and agricultural lands posed by unpredictable periods of prolonged rainfall in the upper watersheds.

This realization, in turn, has led to the understanding that careful management of the floodway is essential to the protection of life and property within the urbanized areas, rural communities, and adjoining agricultural lands. Appropriate floodway management requires continual improvement and maintenance of the levees, control of bank erosion where it threatens levees, management of vegetation near levees, maintenance of levee accessibility, and general control of uses of the floodway so that floodflows are not impeded, the reliability of the levees is not diminished, and flood fight and river rescue are not interfered with or made more dangerous.

Along with this heightened awareness of the need for improved floodway management, there has been an upsurge of interest in reorienting the cities of Sacramento and West Sacramento (following trends across the country) toward the river that used to form only their back door for commerce or waste disposal. Hence, there is now demand for residential and commercial properties facing the river and for the construction of amenities on the riverfront to serve as a new center of civic revitalization. In addition, there is a long-established interest, captured in both federal and state statutes, to protect what little remains of riparian habitat for fish and wildlife species along the river and to restore areas that have been degraded or destroyed, often by flood control practices that removed vegetation to facilitate the movement of flood water. Finally, there is a continuing interest in promoting appropriate public access to the river growing out of the effort in the 1990s to draft and implement the Sacramento River Greenway Plan.

In response to this convergence of trends, the FMP offers guidelines to improve the reliability of the levees, to protect and restore riparian and aquatic habitat, to reorient the cities to the riverfront, and to find ways to build amenities there that give people access to the river while reducing flood risk.

Captured below is a brief summary, a series of snapshots, of critical issues and needs raised during the Forum process that helped give shape to these guidelines.

Existing Conditions and Management Needs

1. Levee and Bank Condition

At the beginning of the Forum, technical consultants indicated that information about the physical and geotechnical condition of levees was incomplete and not obtainable without extremely expensive tests carried out by boring directly into the structures at close intervals. Even test bores would only yield reliable information about those immediate areas. Yet the discussions among reclamation and levee district managers and others with firsthand experience of maintaining, repairing, and inspecting the levees revealed a great deal of information about the history of various stretches of levees and numerous special problems. This helped the Forum gain particular insight into the situation facing the agricultural reclamation districts as well as the urbanized areas. In particular, the Forum held a Levee and Bank Conditions Fact-Finding Panel meeting, which several representatives from local reclamation districts and maintaining agencies attended. The summary of this meeting is located in Appendix A of this document.

The Legacies of an Aging System

The SRFCP was conceived in the late nineteenth and early twentieth centuries when river navigation was an important element of the Sacramento Valley's transportation infrastructure. Hydraulic mining had clogged the river channels and added significant uncertainty and cost to navigation. The SRFCP was designed in part to address this problem. Thus, the mainstem river levees were placed close to the channel so as to confine river flows in flood stage and use the energy of the river to drive hydraulic mining sediments out of the system. This design also reduced the cost of levee construction by taking advantage of the "natural levees" (high ground built up by the river over time) along its banks and by making it possible for existing technology (the clam shell excavator) to efficiently use the sediment in the channel as a borrow source for the levees.

Although well suited to address the technical and financial challenges of a previous era, this design has left a legacy of chronic erosion and seepage that must now be addressed by a succeeding generation of flood managers. Constructing the mainstem river levees close to the edge of the river channel did succeed in driving hydraulic mining debris sediments from the system. Construction of large dams on the mainstem rivers contributed to this process by cutting off the downstream migration of new sources of sediment from the upper watersheds. The dams also introduced a new flow regime to the SRFCP oriented

to the summer irrigation needs of Central Valley farmers. These developments profoundly altered the behavior of the mainstem rivers, setting in motion a new pattern of sediment transport that had the effect of deepening and widening the mainstem river channels at the expense of the berms supporting the levees. Because of the narrowness of the space separating the levees from the river channel, this erosion soon threatened the geotechnical stability of the levees in many places and caused flood managers to take steps to halt the erosion by armoring the affected berms. This merely redirected the river's energy to other portions of the berms, initiating a cycle that made the need for armor so widespread that by the mid-1950s it was clear that bank stabilization efforts would be a permanent requirement of operating the SRFCP.

In addition to erosion, the SRFCP levees are vulnerable to two kinds of seepage risks, as illustrated in Figure 4. The first is *through-levee* seepage. Because many segments of the mainstem levee system were constructed using relatively porous hydraulic mining sediments borrowed from the river channel, some of the levees have a propensity to seep when subjected to prolonged high water surface elevations such as occurred during the floods of 1986 and 1997. Through-levee seepage was deemed a system design deficiency in the aftermath of the 1986 flood, and a substantial capital improvement program has been underway since the early 1990s to address this deficiency.

A second kind of seepage risk is *levee underseepage.* Because the mainstem levees are constructed on high berms relatively close to the river channel, the same energy that the designers harnessed to drive hydraulic mining sediment from the system also exerts itself against the sandy alluvial soil layers that lie beneath the levees. In high flow, this energy is sometimes strong enough to push water through these layers in volumes great enough to create a sustained flow to the surface, an uplift force capable of fracturing the soil mantel landside of the levee. This fracture is referred to as a *boil*. Such boils are not uncommon in major flood events. If they get out of control, the affected soil layer can become a conduit for transporting enough of the sediment beneath the levee to trigger a slump, or failure of the levee structure leading to an uncontrolled flood. Under-seepage may have contributed to some of the levee failures that occurred during the flood of 1997. It may be that underseepage is a significant risk factor throughout the mainstem levee system. But it is a difficult and expensive problem to diagnose because of the intensity and cost involved in the geotechnical explorations necessary to complete the diagnosis.

Funding Inequities for Levee Maintenance and Improvements

The great majority of the levees in this reach of the Sacramento still protect farmlands and small rural towns and residences. It is primarily agricultural landowners, organized into local reclamation districts, who are responsible for the growing expense of maintaining those levees. Where levees protect urbanized lands, the tax base is more valuable, and adequate funds are generated by local assessments to cover the costs of maintenance, but farm economics severely narrow the range of funding options for rural reclamation districts, and the assessments generated in these areas are not enough to get the job done. Not

only are agricultural assessments low to begin with, but also costs of compliance with regulations of recent years have increased sharply. Figure 5 shows the general locations of reclamation districts and maintenance areas bordering the Sacramento River and indicates whether they are predominantly rural reclamation districts or predominantly urban reclamation districts/maintenance areas.

As described above, some local levee districts in rural areas have inadequate annual budgets to repair or upgrade levees. In some cases, the districts cannot meet basic yearly maintenance requirements. Internal drainage of floodplain basins adds to yearly costs. State and federal funding may be (and has recently been) diminished for future local levee repairs and upgrades to SRFCP system infrastructure, especially in rural areas. Sites designated as "critical eroding" in the Corps river bank survey report may require years to fund, permit, and construct repairs or upgrades.

When it comes to new construction, federal and state funding is required to do major work in replacing badly eroded structures or providing permanent rather than patchwork solutions to serious problems. In these cases, the cost-benefit analysis used by the Corps to justify new appropriations to Congress inevitably favors urban areas. Even though all levees in the federal SRFCP are supposed to be designed and maintained to a single set of standards, every dollar invested in a given levee improvement protecting an urbanized area will protect more people and a larger tax base (hence generate more benefit) than the same amount invested in protecting rural communities or agricultural lands. So the urban areas consistently qualify for funding for geotechnical studies and new construction projects, whereas the rural areas consistently do not.

Federal criteria should be adjusted to recognize the need for rural levee protection, making it possible for rural areas to qualify for and receive levee protection funding.

Permitting Process

Every project affecting the banks, berms, and levees requires regulatory approval of flood control and wildlife and resource agencies, yet the exercise of this regulatory authority is hampered by inadequate agency staffing, suboptimal interagency coordination, and a number of conflicting mandates. The result has often been a near paralysis of approval, or costly and risky delays, of projects affecting the levee system.

Changing Conditions and Increasing Risk

Levee conditions and maintenance practices in predominantly agricultural basins may not adequately protect existing rural and urban communities or urban expansion in those basins. Some original levees never met current standards (e.g., maximum 3:1 waterside slope or 20-foot minimum top width). Risk and consequences of levee failure are heightened. Several members of the Forum have become concerned that an overall evaluation of the condition of levees in

such changing basins does not seem to be the direct responsibility of any local, state, or federal agency.

Conversion of levee access roads to public roads and highways with guardrails and traffic hinders levee inspection and routine maintenance. Flood fighting is rendered more difficult, and safety of crews is lessened. Contemporary levees may be constructed on top of historical levees with weak or uncertain foundations (sandy, caving, seepage) or with overly steep waterside slopes, as illustrated in Figure 6. Substandard levees with eroding banks in some locations may fail if upgrades or setbacks are not constructed. There is uncertainty about the cascade effect on urban areas of levee breaches that may occur in agricultural zones (i.e., levee failures in rural areas leading to failures of a succession of neighboring, inter-basin levees until finally reaching an urban levee area).

An increase in the number and size of boats on the river has greatly accelerated bank and berm erosion during the non-flood season through wake wave action. The cumulative effect of boat wakes has caused a 6-foot-high scour zone on lower banks and levee slopes throughout the corridor. Scientific analysis and recent trends suggest that further, chronic bank erosion is likely in the corridor. Because there is little berm remaining inside the levees, there will be an unavoidable need to increase the extent of bank hardening projects. Rock riprap (a large, angular rock layer placed on slopes) will be the most common material used, especially on lower banks supporting levees above.

2. Habitat Conservation

The design of the SRFCP, as noted above, created a relatively narrow floodway by setting levees close to the normal summer flow channel of the river; the pre-project river historically had flooded out over miles of valley bottomland during the rainy and spring snowmelt seasons of the water year. This meant that vast areas of riparian forest and wetlands, previously receiving annual inundation, were cut off from the river permanently, and the land gradually drained and turned to other uses. At the same time, the gradual expansion of the confined river channel through erosion of the berms separating the channel from the levees reduced the extent of the remnant riparian forest and led to the armoring of the affected levees and banks, which accelerated the loss of vegetation. For many miles of the river reach in Sacramento, especially south of the metropolitan area, virtually none of the original riparian forest remains. Rock-lined levees run right to the water's edge with little or no remaining bank. The loss of overhanging and instream vegetation has greatly reduced the protective cover and feeding habitat for many fish species, and contributes to the threatened or endangered status of salmon and steelhead runs.

Threats to Surviving Habitat

Not only is past damage largely irreversible, but also ongoing bank erosion continues to damage or threaten riparian vegetation and fish habitat and trigger the installation of bank revetment to halt bank retreat near levees. Most of the

50-mile corridor has armored banks, but even old riprap banks have been damaged by river dynamics, such as bed scour and loss of the toe of the bank.

Where natural vegetation remains, it faces an uncertain future. Mature riparian forest, particularly cottonwood and valley oak trees, are not being replaced by natural colonization because of over-steepened banks and altered hydrology caused by the storage reservoir system. Many large riparian trees are being lost each year to bank erosion and old age decline. Existing shoreline habitat and forest canopy are discontinuous, broken up by large bank segments devoid of vegetation.

In addition to erosion caused by the original design and current operation of the SRFCP, boat wakes cause incremental but persistent loss of soft bank, berms, and shoreline vegetation along the lower banks of the river corridor. Unlike erosion caused by infrequent, major flood events, boat wake erosion is persistent, occurs year-round, and will increase with an expected increase in recreational and tourist boat traffic. Wake erosion is the primary cause of soil and vegetation loss and undercut banks in a 6–8-inch band above the summer low water level.

In addition, invasive, nonnative plants displace native vegetation, while also curtailing the efficient inspection of levees. There is a scarcity of low, relatively flat surfaces along the river that can be colonized by native, moisture-seeking trees and shrubs.

Needs of Fish and Wildlife

Juvenile salmon and steelhead rely on river shoreline cover and shade during their out-migration and growth cycles. Cover for fish, such as overhanging tree canopy and submerged wood or herbaceous vegetation, is inadequate or absent along most of the river corridor. Juvenile salmonids have been documented in recent years to experience better growth rates and higher survival while outmigrating and feeding in the Yolo Bypass compared to relatively more sterile conditions and higher predation rates in the Sacramento River corridor. The loss of shallow, seasonally inundated floodplain with vegetative cover adjacent to the river is considered to be a major, system-wide loss to river ecosystem functions, and an important factor in the declining success of juvenile fish migrations as well as Delta native fish species that spawn on shallow floodplains in the spring.

Many terrestrial and semi-aquatic animals require habitat structure with sufficient continuity and patch size to sustain native populations. Most of the river corridor does not offer wildlife these conditions. The presence of the flood control levee system confines riparian habitat to a narrow or nonexistent thread along the river. With few exceptions, there are no large nodes of habitat remaining downstream of Colusa.

Public Agency Requirements and Policies

Anticipated and planned bank and levee stabilization projects will likely require both on-site and off-site habitat mitigation features that actually may improve shoreline habitat conditions and add shade tree canopy to the urban forest.

Levee setbacks by regional and local flood control agencies are planned or under consideration along sites within the floodway corridor. The primary purpose of setback levees is to move levees away from the threat of eroding banks. Setback land could also offer significant new opportunities for riparian, aquatic, and terrestrial habitat expansion, and for low floodplain creation, which is an important component of seasonal aquatic habitat.

A near absence of waterside berms in the levee system means that trees must be planted in the slope of the levee cross section. This is at odds with routine state and Corps guidelines for planting trees in levees constructed to meet minimum state and federal standards.

Many Sacramento River Bank Protection Project (SRBPP)–designated levees have waterside slopes steeper than the recommended minimum 3:1 slope, and some locations are even steeper than 2:1 (Figures 6 and 7). Steep bank slopes are difficult to plant, and planting may not be permitted under levee protection standards. In general, standard engineering criteria discourage incorporation of "soft" bank features, such as plantings, submerged woody cover for fish, or exposed soil.

Levee setbacks are not a realistic option in the urbanized portions of the 50-mile floodway. River habitat along existing "setbacks" (e.g., Garden Highway upstream of Interstate 80) is being removed or damaged piecemeal by private residential and dock access projects, and by ongoing bank erosion.

Developing a series of innovative techniques for responding to these challenging conditions has been a major effort of the guidelines in the FMP. Many of these guidelines were developed through the fact-finding panel process. A summary of the Habitat Conservation Fact-Finding Panel meeting is located in Appendix A of this document.

3. Public Access

Although public access was always included in the list of guidelines to be developed by the Forum, the role of the issue became more central as many interest groups formed a public access caucus and came to focus their efforts on the key role it plays in so many aspects of managing the flood control system and developing the cities' waterfronts. The Forum convened a fact-finding panel on September 14, 2004 to further the understanding of public access issues. A summary of this meeting can be found in Appendix A of this document. A main outcome of the fact-finding panel was a clearly expressed desire among attendees that guidelines encourage the continuity of public access along the Sacramento River. Access improvements could take several forms, depending on location

and surrounding land uses. Public access, if designed properly, can be a compatible and complementary use with levee operations and maintenance (O&M) and floodfight activities. For example, public parking lots could be used as staging areas during flood fights.

Disparate and uncoordinated forms of public access and recreational uses sometimes create conflicts. There are relatively few formal sites for public access for such activities as fishing, and people often park on the levee road where there is no shoulder or other room for parking, thus blocking traffic or damaging the levee crown. They scramble down the sides of levees to create their own fishing spots, thus damaging both the levee slopes and any riparian vegetation at the site. Further, they often do this at sites that are private property.

A key problem identified was how to create incentives for people to go to planned, well-designed areas of public access rather than seeking out their own trails, with consequent damage to levees and habitat. There seemed to be common interest in concentrating river recreation and access at a smaller number of sites with appropriate facilities, maintenance, and safety. It may be possible to attract a majority of the fisherman to formal fishing spots with incentives, but others will continue to seek out their favorite holes. It would be desirable to map these informal bank and boat fishing spots.

In the case of private commercial riverfront development, it should be possible to devise incentives for commercial developers to establish public access points. There can be a commercial tradeoff in providing public access as part of each new project. The Bay Conservation and Development Commission has been successful with this approach and may provide relevant examples. Viable commercial uses do not need to block access—they can advance it.

Types of public access should match the surrounding land use. For urban areas, this could mean pedestrian access, promenades, docks, and trails. For subdivisions, it could mean linear parks and setting development back from the levees. For rural areas, it could mean providing formal access opportunities in combination with visual access from levee roads.

In rural areas, funding for O&M of existing and future public access facilities is inadequate. Nevertheless, public access should be directed to areas suitable for the type of access envisioned, e.g., designate an area for fishing that is known as a good fishing spot, avoid sensitive species habitat, and, where feasible, provide for continuous bike or pedestrian access.

Guarantees of public access to private lands adjacent to riverways raise questions of liability. Private property rights need to be protected. Farmers and other private landowners must be included as stakeholders in the public policy debate.

4. Land Use and Levee Protection

Many Forum members, especially those in the flood control community, came to focus on the need for enhanced access to the landside of the levees to meet a

variety of needs. Title 23 mandates a 10-foot clear zone on the landside toe of a levee where no structures are allowed (Figure 2). The ideal situation, from a flood control perspective, is a drainage ditch at the toe of the levee and a road built in the 10-foot clear zone. This facilitates levee inspections at the landside toe, which is the most likely place for problems to occur. While levee-top roads are also valuable for inspections, roads at the base of the levee on the landward side allow for operations and maintenance activities.

The engineers emphasized, however, that in a flood fight more than 10 feet is needed. If there is not enough room for trucks to turn around, equipment is forced to take a "one way" route. At a point when time is most critical, valuable time is lost by routing equipment in a circular path. Additional clearance is also needed for reconstructing substandard levees and repairing damage from flooding. Despite the need for such a cleared zone, many subdivisions within the cities have built houses right up to the landward toe of the levees, making inspections and access much more difficult.

A larger cleared area could lend itself to linear parks. Public access advocates felt such areas could be supportive of their goals for continuous access along the river, and habitat conservation experts believed that terrestrial wildlife would also benefit from additional vegetation and cover as they sought safe pathways to the water.

For these varied reasons, Forum members began to explore the possibility of incorporating in the FMP guidelines that would encourage land use agencies to work with developers of presently undeveloped land to expand the area designated for open space uses along the landside toe of the levees, consistent with long-term flood control system maintenance and improvement needs and to consider the importance of creating a "Levee Protection Area" in undeveloped areas protected by levees with unknown foundation conditions. A workshop was held for members of the Forum in March 2005 to explore the issues behind the need for the Levee Protection Area (see Appendix A).

5. Nodes of Development

As Forum members pointed out early in the discussions, riverfront development has been clustered, for the most part, in the Sacramento–West Sacramento metropolitan area. Most of the corridor consists of agricultural lands where there are no subdivisions and little demand for commercial projects within the floodway. This pattern is confirmed in the existing land use designations of the General Plans of the counties and cities. Development is confined to the nodes of urban development, including the Sacramento area and such small towns as Freeport, Clarksburg, and Courtland. These nodes of development are mapped in Figure A-1, "Anticipated Development," in Appendix A of this document. That nodal pattern seemed also to be confirmed in the future projections of the SACOG Blueprint, which the Forum consulted. All the scenarios considered in that planning exercise for the 50-year future of the region indicated that development would conform fairly closely to those existing nodes.

It should be noted that the SACOG Blueprint's analytical strength is as a macro, large-scale planning tool, rather than a tool for evaluating a specific project; each project should be evaluated on its own merits.

The Forum members considered this an important characteristic of the future of the corridor, and some felt that if hydraulic modeling indicated no additional strain on the flood control system, perhaps different levels of development could be permissible in the urban nodes than in the rural areas. Thus, there are some geographical distinctions offered as to the applicability of some guidelines, as they apply to features more appropriate to high-density urban nodes than to lightly populated agricultural areas. Additional background information regarding riverfront development and land use in the corridor can be found in the Riverfront Development Fact-Finding Panel Summary and the Land Use Fact-Finding Panel Summary in Appendix A of this document.

Developing the Guidelines

The above issues are examples of the complex conditions and management needs cited by Forum members for proposed guidelines that form the basis of the FMP. Throughout discussions, the group emphasized the need to match guidelines to site-specific, existing conditions, as they varied within this reach of the river corridor. Members recognized that while some conditions might exist throughout this reach, others were unique to the most intensively developed urban nodes of development, particularly the area of the downtown metropolitan area, the core of the cities of Sacramento and West Sacramento.

As noted in the previous section, the first challenge of the Forum was to develop a set of guidelines appropriate to the particular features proposed by the SRMP brought forward by the two cities in 2003. The next challenge was to develop guidelines appropriate to the rural areas in the remainder of the 50-mile reach of the river. The next section (Section 3) presents an integrated draft of these two sets of guidelines with clear indications of the geographic scope and applicability of each provision.

Section 3

River Corridor Floodway Guidelines

Mission of the Sacramento River Corridor Planning Forum

Consistent with the original convening report, the purpose of the Forum is to achieve greater certainty and predictability in the permitting process through the development of flood management guidelines for commercial development, landscaping or riparian habitat, and public recreation and access facilities contemplated within or along the floodway (a summary table of anticipated river-related regulations, regulatory agencies, and approvals for Sacramento River projects can be found in Appendix D of this document). The scope of the draft guidelines included in this document has been refined and expanded to address not only the proposed SRMP (the focus of the Forum's Phase 1 effort), but also the many additional issues affecting management of the floodway between the Fremont Weir and the town of Courtland. The guidelines are based on existing information and the level of detail available regarding future land uses, individual projects, and various natural resource and flood control management needs and, therefore, additional criteria may be applied during the planning or design phase of a specific project.

Overall Goal for River Corridor Floodway

The overall goal of the FMP guidelines is to improve the functionality of the flood control system and minimize potential flood impacts while accommodating the public's desire to use and enjoy the Sacramento River as:

- a lifeline for Central Valley agriculture,
- an urban amenity,
- an economic asset,
- an open space corridor, and
- a restored riparian and aquatic ecosystem that also conveys millions of acre-feet of water to San Joaquin farmers and southern California population centers.

Overall Floodway Planning and Design Guidelines

The development of floodway guidelines has been informed by an important underlying assumption that has guided the proceedings of the Forum from its inception, namely that the greatest challenge to the safety and viability of the flood control system is uncertainty about the future conditions and capacity of the floodway and levees as cities grow and redevelop their waterfront.

Growth in the study area is controlled by the cities and counties using their existing land use authority. An understanding of existing and future land uses in the area was developed through review of land use plans (e.g., general plans, specific plans), various planning processes (SRMP, SACOG Blueprint), and interaction with agency planning staff and applied to the forming of many of the guidelines. This understanding of the future template of the study area has enabled the Forum and its technical work groups to evaluate at a hypothetical level how the physical features and increased usage in and around the river corridor will affect the floodway, and to constructively influence the implementation of future projects by developing implementation guidelines to ensure that future projects complement and enhance floodway operation and maintenance.

All projects within and adjacent to the river corridor should be deliberately designed and constructed in a manner that is consistent with these guidelines. Plan implementation that is consistent with these guidelines is expected to collectively result in an overall net benefit for the river corridor as a shared resource and to contribute to improved flood control functionality and reliability. The following overall guidelines (OGs) apply to all projects within and adjacent to the river corridor. In general, projects should be designed to:

OG1 Improve the stability of eroding or unstable streambanks and levee slopes.

OG2 Improve and maintain the ability to inspect levees and floodwalls.

OG3 Improve access for levee and bank protection maintenance activities.

OG4 Maintain or improve flood conveyance capacity and reliability.

OG5 Reduce navigation- and flood-related impacts to provide for safety of the public and for river and floodway management personnel.

OG6 Limit the damage vulnerability of new structures, riparian vegetation, and other improvements (e.g., trails, overlooks, etc.) along the river corridor caused by major floods and more common high-stage river flows.

OG7 Incorporate public recreation and access facilities into the river corridor, particularly as a part of new development, to provide continuous access to and along the river, to the maximum extent feasible. Various types of access should be considered, including physical, visual, vehicular, bicycle, pedestrian, equestrian, rail, boat, fishing, and/or interpretive, dependent on location and site conditions.

OG8 Design riverfront development to minimize or avoid impacts on the flood control system and flood conveyance facilities.

OG9 Assess cross-flooding potential between leveed sub-basins. Where needed, upgrade or construct additional cross levees or drains to ensure that potential future levee breaches in one sub-basin do not cascade through and flood an adjacent sub-basin, particularly urban basins.

OG10 Riparian habitat should be preserved, restored, and increased throughout the corridor to enhance ecosystem values and improve the natural character of the river system. Habitat enhancement should be integrated with flood control projects and operation and maintenance activities to protect resources, balance needs, and capitalize on common interests.

Improved Bank Protection and Levee Stability

The stability of riverbanks and levees along the Sacramento River is a critical component in maintaining the reliability of the flood control system. The condition of riverbanks and levees along the SRFCP has been threatened by erosion since construction. This erosion is an ongoing process associated with both normal river processes and human activities. Geologic and hydrogeologic processes such as seismically induced ground movement, foundation material slope failures, and seepage also threaten levee stability. The materials and methods used in the original construction of the Sacramento River levees make the system susceptible to damage and create uncertainties in the analysis of levee stability. Limited funding affects the ability of some maintaining agencies in agricultural basins to conduct needed inspection, maintenance, and repair of levees and precludes major investment in levee rehabilitation, upgrades, and bank protection.

The goals of the Improved Bank Protection and Levee Stability guidelines are to:

- facilitate better levee maintenance, inspection, and repair;
- guide the design, review, and permitting of projects to ensure bank and levee stability in the study area; and
- create the flexibility to construct improvements and generally upgrade flood control system infrastructure and function to a higher level of protection and security in the future.

Guidelines for Bank and Levee Protection

The actual performance of the SRFCP is tested only in rare flood events, and history indicates that the locations and extent of weak points in the system during flood events are highly unpredictable. A primary geotechnical concern is levee stability during flood and drawdown conditions, especially from the destabilizing effect of water seepage through or under the levee. The variability in levee and foundation materials makes assessment of these problems difficult, requiring extensive subsurface exploration to reduce uncertainty. Even after comprehensive analysis, some uncertainty remains because of vulnerability of

levees to relatively small-scale problems (e.g., beaver or other animal burrows, tree collapse) and general degradation over time.

The narrow river corridor and its proximity to the levees have caused erosion and posed a constant threat to the SRFCP since its construction. The Corps has countered this erosion with revetment (typically large, angular rock covering bank slopes, as in Figure 7) installed under the SRBPP, but funding for the project has limited its application to sites identified as "critical" (indicating an imminent threat to the levee system). Some maintaining agencies, such as DWR, have also installed extensive bank protection. Smaller levee districts generally do not have the resources to design and construct major bank protection projects and, as a result, have relegated large bank protection projects nearly entirely to the Corps and the Reclamation Board (non-federal partner in SRBPP).

Levee inspection and maintenance are performed by a number of Reclamation Districts, the American River Flood Control District, City of Sacramento, and DWR. Funding mechanisms and operating budgets vary, but in some districts consisting of predominantly agricultural lands and rural communities, the revenues available for inspection, maintenance, and repair of the system are extremely limited. Rural reclamation districts contain a relatively small number of agricultural property owners and rural residential landowners who contribute to district funding. These districts have relatively low value per acre of land, compared to predominantly urban levee maintenance districts, and therefore a much lower potential fee for levee district services. This situation limits the ability of these districts to perform annual maintenance and repair activities and heightens concerns regarding the reliability of these levees, which generally have not been investigated thoroughly and in places do not conform to the geometric template (3:1 slopes waterside; 2:1 landside) established as minimally acceptable for the SRFCP (Figure 2). The consequences of failure of these levees are troubling because of the risk to existing rural communities, as well as when additional urbanization occurs. In some cases, local levee failures bordering agricultural areas might have a cascade effect caused by levee saturation and wind waves destabilizing interior basin levees surrounding urban sub-basins.

Information regarding the levees and banks of the flood control system is developed and maintained by a large number of agencies. Valuable information is sometimes not readily accessible, and information gaps are not easily assessed. A more centralized source of information for the flood control system is needed, including basic topographic and hydraulic information; information on levee and bank conditions; maintaining agency contacts; maintenance, repair, and upgrade updates; and technical studies and reports.

Guidelines for Structures on Levees

In the context of these guidelines, the term *structure* refers to constructed improvements that extend above existing ground elevations on the levee and within the floodway. Structures include, but are not limited to, retaining walls, access ramps, stairways, recreation facilities, planters, lights, signs, and displays. Roads and paths constructed on grade are not considered to be structures. Note that this definition is broader than the definition of structures in Title 23, as it is

not limited to buildings. While the SRMP does not propose construction of buildings on the levee or within the floodway for the downtown stretch of the river, and there are no known plans or proposals to place buildings on levees or within the floodway outside the SRMP, such projects may be proposed at a later date in the remainder of the corridor.

If such a project were proposed, structures in the floodway must be carefully designed to avoid adverse impacts on access for O&M of the flood protection system, including emergency operations during floods. Structures on or near levees must also be designed such that the stability of the levee is not threatened, including its susceptibility to damage from seepage.

Where new facilities are to be constructed, an opportunity may exist to incorporate modifications to existing levees and floodway facilities that ensure that the result is a net benefit in the reliability of the flood protection system. There may be local areas where current design standards for levee geometry, stability, seepage, erosion protection, or other considerations are not being met. When new facilities are constructed, the opportunity for bringing affected flood control facilities into compliance with or exceeding current standards should be considered by the permitting and land use agencies. If the project is located in a rural community, however, state and federal assistance may be necessary for full compliance to be feasible.

A structure that projects above the ground surface in the floodway has the potential to induce local turbulence that can lead to bank or levee erosion during periods of high flow. Where a berm is present between the main channel and the levee, these concerns are reduced somewhat by the lower velocities that typically occur in these areas. Therefore, in areas where a berm exists, engineering analysis is needed to demonstrate on a site-specific basis whether such structures can be built without need for further protection of the bank or levees. In areas where a significant berm is not present, projecting structures result in the requirement of bank protection as an integral component of the proposed project to ensure the integrity of the levee.

Structures on Levees

The guidelines for structures on levees (LS) are below. Note that these guidelines do not apply to floating or moored structures or marinas, which are discussed in other sub-sections.

Location	Guideline		Responsibility
Entire corridor	**LS1**	Limit structures on the levee to minor facilities (e.g., ramps, stairs, bike trails, maintenance roads, pedestrian amenities, restrooms, sanitation facilities) required for public access, transportation, utilities and drainage, and flood safety that are maintained and operated by public agencies, or for typical agricultural road access.	County and city planning agencies and building departments

Location	Guideline		Responsibility
Entire corridor	**LS2**	Design permanent structures to protrude 3 feet or less above the ground surface within the floodway, or support larger structures on piles or towers that allow passage of floodflows under the structure. Design access gangways and other structures between the levee top and the floodway to be removable to allow for future levee or floodwall maintenance and repairs. If structures require excavation into the levee surface, provide a levee stability and seepage analysis consistent with U.S. Army Corps of Engineers (Corps) procedures for Sacramento River levees.	Project Proponents and county and city planning agencies and building departments
Entire corridor	**LS3**	Provide an unobstructed levee road width of 20 feet or more between structures in all locations. Multiple-use roadway geometry shall accommodate passage of emergency vehicles and heavy construction equipment on an all-weather surface.	Project Proponents and county and city planning agencies and building departments
Entire corridor	**LS4**	Where new structures are to be constructed, re-grade any levee slopes in the vicinity that are steeper than 3:1 on the waterside and 2:1 on the landside to these minimums.	Project Proponents and county and city planning agencies and building departments
Entire corridor	**LS5**	Where retaining structures are proposed, conduct a levee stability analysis to demonstrate that the proposed improvements result in control of seepage and levee stability characteristics that meet Corps current design standards for the levee system. Design retaining structures to accommodate maintenance, normal inspections, and flood patrols, including access to the levee surface and toe, and visibility of the levee and adjacent toe area from the roadway on top.	Project Proponents and county and city planning agencies and building departments
Entire corridor	**LS6**	Avoid use of solid structures, walls, fences, and other features (excluding those described in LS1) that are linear in nature and perpendicular to flow direction, or that form a significant hydraulic barrier or collection point for debris.	Project Proponents and county and city planning agencies and building departments
Entire corridor	**LS7**	Avoid construction of features that project from the waterside of the levee surface, unless the bank and levee are adequately protected from erosion and bed scour. Recognize that erosion is a continuing process and that additional bank protection may be required to protect existing high value structures.	Project Proponents and county and city planning agencies and building departments
Entire corridor	**LS8**	Where structures require utilities to be placed in the levee section or within 50 feet of the levee toe, provide automatic shutdown for pressurized fluid and electrical systems if a failure or breakage occurs and provide shutdown valves or switches at major access points. Utility installations shall be designed and constructed so that they do not provide a potential seepage path.	Project Proponents and county and city planning agencies and building departments

Derelict Structures on Levees and Submerged Banks

There are many abandoned or unused structures along the banks and within the floodway channel that are relicts of previous industrial, water diversion, and marine facilities. Common examples include clusters of wood, steel, or concrete piers and abutments, old wharves and loading docks, remnants of abandoned marina facilities, and abandoned flap gates or culverts with headwalls. These

features individually and collectively present hazards to river navigation, attract large rafts of floating debris, and cause local deflection currents that exacerbate erosion of the adjacent bank and riverbed. These structures are referred to as *derelict structures*.

During floodflows, these unnecessary encroachments may adversely affect the local hydraulic characteristics of the floodway, especially when large masses of debris have lodged against them. They also detract from river viewsheds and contribute to a negative public perception of the value of the river corridor. Eventual systematic removal, or repair and modification, of derelict structures is an objective of the guidelines and will be an asset to the flood control system reliability.

The removal or modification of some derelict or abandoned structures may require prior consultation with the State Historic Preservation Office (SHPO) within the California Department of Parks and Recreation, as some structures may be considered historic structures (e.g., gold rush era). Additionally, Resource Agencies should be consulted with regard to potential habitat impacts.

The guidelines for derelict structures on levees and submerged banks (DS) are:

Location	Guideline		Responsibility
Entire corridor	**DS1**	Remove derelict or abandoned structures not having potential for repair and reuse from the levee and floodway when adjacent features of new projects are planned or constructed, as part of a general, corridor-wide channel improvement project, or as an element of special area plan or Specific Plan.	Project proponents and county and city planning agencies and building departments
SRMP area only	**DS2**	Over the complete implementation phase of the SRMP, remove derelict and abandoned structures not having potential for repair and useful conversion to other approved SRMP purposes, such as public access, transportation, utilities and drainage, and flood safety.	Project proponents and county and city planning agencies and building departments

The trigger for obligatory initiation of derelict structure removal at specific sites is when a project is implemented that requires modification of the channel, bank, or levee slope adjacent to abandoned features. Examples of trigger projects include marinas and guest docks, bridges, bank protection and/or mitigation planting, and trails, roads, or other access features that modify the banks or levee slopes of the floodway channel.

Structures on Oversized Levees

The term *oversized levee* as used here refers to atypical conditions where the floodway levee is non-standard in shape and often significantly oversized as a result of placement of fill material (the location of current and proposed oversized levees are illustrated in Figure 8, and the geometry typical of oversized levees is illustrated in Figure 9). In the SRMP area, the location and configuration of the original levees have been or are anticipated to be modified

by placement of fill and/or construction of concrete walls, bulkheads, and other structures. These extensive structural and backfill modifications to project levees often exceed the state's definition of a standard project levee, and represent substantial improvements to the stability of the original levee condition which may have been built to minimum allowable dimensions.

In some areas on the left bank (east side (see Figure 10), a floodwall or bulkhead is present at the riverbank, such as the high concrete retaining wall fronting Old Sacramento and the Embassy Suites hotel and promenade. Flood walls are found from approximately 800 feet upstream of the I Street Bridge to approximately 2,000 feet downstream of the Tower Bridge. The flood wall and its associated support features (e.g., wall stability anchors, buttresses) are an integral part of the flood control system infrastructure and equally subject to protection and regulation under Title 23 and by the SRMP Guidelines.

Other areas along the left bank that are currently protected by levees with typical dimensions are being considered for substantial modification as a part of the City of Sacramento's Docks Project. Fill will be placed on the landside of the levee thereby increasing the top width of the levee up to 100 feet. The result will be a substantially oversized levee.

The following guidelines rely in part on an urban design standard which is more fully described in the section titled "Guidelines for Hydraulic Capacity Design Parameters." The guidelines for structures on oversized levees (OL) are:

Location	Guideline		Responsibility
Downtown area only	**OL1**	In general, these guidelines apply to the area as delineated in the definition sketches shown in figure 8.	County and city planning agencies and building departments
Downtown area only	**OL2**	Limit structures located within 50 feet of the waterside top of bank to infrastructure required for public access, transportation, utilities and drainage, and flood safety features to be maintained and operated by public agencies.	County and city planning agencies and building departments
Downtown area only	**OL3**	Existing oversized levees and standard levees that are filled to create oversized levees require that access to the original levee structure be maintained for levee and floodway maintenance and inspection purposes. Structures on oversized levees shall be setback so as to not hinder access. The setback is defined by the area consisting of a 3:1 waterside slope extending up to the top elevation of the urban design standard, a crown width of 20 feet, and a 2:1 downward slope extending landward to native grade. This distance shall be a minimum of 50 feet (see Figure 9).	Project proponents and county and city planning agencies and building departments

Location	Guideline		Responsibility
Downtown area only	**OL4**	Within the setback, provide an unobstructed levee road width of 20 feet or more between structures in all locations. Multiple-use roadway geometry shall accommodate passage of emergency vehicles and heavy construction equipment on an all-weather surface. Perpendicular access at regular intervals to be provided as described in "Guidelines for Good Access to Levee Roads".	Project proponents and county and city planning agencies and building departments
Downtown area only	**OL5**	Limit structures within the setback to minor facilities (e.g., bike trails, maintenance roads, pedestrian amenities, restrooms, sanitation facilities, utility trenches) required for public access, transportation, utilities and drainage, and flood safety that are controlled and operated by public agencies.	Project proponents and county and city planning agencies and building departments
Downtown area only	**OL6**	Allow for additional riparian vegetation and shade trees along the waterside slope, top of levee, and landside slope consistent with Title 23 as it relates to woody vegetation on oversized levees.	Project proponents and county and city planning agencies and building departments
Downtown area only	**OL7**	Avoid projection of new retaining structures into the river channel to limit adverse flow obstruction and deflection currents that may cause local bank erosion or bed scour. Where structures are located within the 3:1 slope projection as defined in Figure 9, demonstrate adequate geotechnical stability, and protection from bank and toe scour and lateral bank migration.	Project proponents and county and city planning agencies and building departments
Downtown area only	**OL8**	Incorporate levee road access at regular intervals, as described in the next Improved Levee and Floodway Maintenance and Road Access section, with a designated access route having a minimum 20-foot unobstructed width or wider.	Project proponents and county and city planning agencies and building departments
Downtown area only	**OL9**	Construct smooth transitions to existing levee slopes upstream and downstream of structures. Where feasible, incorporate plantings or other elements that match the general hydraulic roughness of the bank segments upstream and downstream.	Project proponents and county and city planning agencies and building departments
Downtown area only	**OL10**	Where retaining structures are proposed, conduct a slope stability analysis to demonstrate that the proposed improvements result in slope stability characteristics that meet current design standards for the levee system.	Project proponents and county and city planning agencies and building departments
Downtown area only	**OL11**	Avoid the use of solid structures, walls, fences, and other features that are linear in nature and perpendicular to flow direction, or that form a significant barrier or collection point for floating debris.	Project proponents and county and city planning agencies and building departments

Location	Guideline		Responsibility
Downtown area only	**OL12**	Where structures require utilities to be placed in the area covered by these guidelines and Title 23, provide automatic shutdown for pressurized fluid and electrical systems if a failure or breakage occurs, and provide shutdown switches or valves for each reach at major access points. Limit utilities installed perpendicular to the levee, or within 20 feet of the top of bank, to the minimum required electrical and water services to support public access facilities.	Project proponents and county and city planning agencies and building departments
Downtown area only	**OL13**	Implement a periodic inspection and maintenance program to identify settlement, erosion, toe scour, debris collection, or other problems that may affect flood safety. Conduct special, detailed inspections during and following major flood events.	State and local flood control agencies

Structures on High Ground

On the right bank (west side) of the river in the vicinity of West Sacramento between the Tower Bridge and the Stone Locks, the riverbank consists of high ground that is as high or higher than adjacent flood control levees and extends landward at least 300 feet, in many locations much wider than 300 feet. Its morphology appears to have been heavily influenced by earlier human activity (e.g., placement of river sediment dredge spoils). The area has been high ground for over 75 years, based on a review of historical photographs and maps, and has supported major infrastructure and structures such as railroad lines and agricultural/industrial warehouses in close proximity to the riverbank.

Recent geotechnical reports indicate that it is a generally stable land mass. While the high ground is identified on system-wide maps as an element of the Sacramento River Flood Control Project due to its location within the levee system, there is no record of state or federal flood control easements or levee projects. Local easements for RD 900 date back to 1911.

The following guidelines rely, in part, on an urban design standard which is more fully described in the section titled "Guidelines for Hydraulic Capacity Design Parameters." The guidelines for structures on high ground (HG) are:

Location	Guideline		Responsibility
High Ground area as shown in Figure 8	**HG1**	To qualify as high ground, ground elevations must be at or above the urban design standard water surface elevation (200-year flood) plus one foot for a minimum distance of 300 feet, and ground slopes landward of this distance must be less than 10 percent for an additional 700 feet.	County and city planning agencies and building departments

Location	Guideline		Responsibility
High Ground area as shown in Figure 8	**HG2**	Structures shall be setback a minimum of 35 feet from the point at which the projected 3:1 slope intersects the elevation of high ground, as described under "Guidelines for Hydraulic Capacity Design Parameters" (also see Figure 11).	Project proponents and county and city planning agencies and building departments
High Ground area as shown in Figure 8	**HG3**	Within the setback, provide an unobstructed levee road width of 20 feet or more between structures in all locations. Multiple-use roadway geometry shall accommodate passage of emergency vehicles and heavy construction equipment on an all-weather surface. Perpendicular access at regular intervals to be provided as described in "Guidelines for Good Access to Levee Roads."	Project proponents and county and city planning agencies and building departments
High Ground area as shown in Figure 8	**HG4**	Limit structures within the setback to minor facilities (e.g., bike trails, maintenance roads, pedestrian amenities, restrooms, sanitation facilities, utility trenches) required for public access, transportation, utilities and drainage, and flood safety that are controlled and operated by public agencies.	Project proponents and county and city planning agencies and building departments
High Ground area as shown in Figure 8	**HG5**	Seepage potential with the assumed water surface at the urban design profile must meet current Corps criteria for levees, as determined by a geotechnical analysis.	Project proponents and county and city planning agencies and building departments
High Ground area as shown in Figure 8	**HG6**	Foundations of structures shall be designed to prevent settlement or stability problems of the high ground due to seepage, and be stable where buildings may potentially be subjected to seepage effects.	Project proponents and county and city planning agencies and building departments
High Ground area as shown in Figure 8	**HG7**	Foundations of structures shall be constructed using methods that prevent damage to waterside slopes or otherwise adversely affect management and maintenance of the flood control system.	Project proponents and county and city planning agencies and building departments
High Ground area as shown in Figure B-1	**HG8**	Foundations of structures shall be sited and designed to allow excavation within the 35-foot setback area if necessary for flood control system maintenance (i.e. if the setback area were excavated, the structural integrity of the foundation, and therefore the building, would not be jeopardized).	Project proponents and county and city planning agencies and building departments
High Ground area as shown in Figure 8	**HG9**	The local land use authority and flood control maintaining agency must have adequate resources to implement and maintain necessary bank stabilization measures to hold bank geometry and protect the 3:1 projected bank slope. A source of additional resources shall be identified if they do not currently exist.	Project proponents and county and city planning agencies and building departments

Future Bank Protection Projects

Erosion of banks and levees of the Sacramento River is an ongoing process associated with both normal river processes and human activities. As noted in

the discussion of structures above, construction and protection of some projects may require re-grading and installation of bank armor to produce a berm that can be demonstrated to provide stable conditions and a suitable buffer against levee erosion (Figure 7). The need for bank protection at particular sites depends on site-specific conditions and the location and design of the proposed new project. In general, locations that have an existing berm between the main channel and the levee are less of an erosion concern in the short term because of lower velocities in the berm areas and a small land buffer between the active channel and the levee prism. However, the banks of berms buffering levees and supporting riparian forest continue to be lost to ongoing erosion.

In some areas, bank protection may be required to protect facilities that run parallel to the levee crest, such as pedestrian or bicycle paths at the top of a bank or bluff. The amount of bank protection required for these facilities can be reduced by constructing benches and setting facilities back from the main channel as far as feasible. This approach also will promote an emphasis on vegetation to help stabilize the riverbanks (see Appendix A, "River Conservation and Habitat Fact Finding Notes"). Figure 12 shows vegetation and habitat features that have been applied to typical bank protection treatments on the Sacrmento River. Appendix C contains several river cross sections showing conceptual bank stabilization treatments incorporating riparian vegetation and fish habitat features.

The guidelines for future bank protection projects (BP) are:

Location	Guideline		Responsibility
Entire corridor	**BP1**	The need for bank protection should be thoroughly evaluated at locations where structures are to be constructed in the floodway in areas without existing bank slope protection. In designing new bank protection for riverside projects, evaluate the use of alternatives to continuous rock revetment to accumulate sediments and widen the vegetated margin of the river channel near the summer water surface and at the toe of the bank, and emphasize the use of vegetated techniques where feasible.	Project proponents in conjunction with state and local flood control agencies
Entire corridor	**BP2**	In areas where bank protection exists, or sites with a berm wider than 30 feet, evaluate the effectiveness and need for additional bank protection associated with proposed new facilities.	State and local flood control agencies
Entire corridor	**BP3**	In areas with a berm where bank erosion is evident, implement measures to protect existing environmental resources such as mature riparian forest, preserve the berm, and protect facilities.	State and local flood control agencies
Entire corridor	**BP4**	Coordinate with the resource agencies (the Corps, U.S. Fish and Wildlife Service, National Marine Fisheries Service, California Department of Fish and Game) to adopt standard design and construction techniques to conserve and replace the ecological values and functions of riparian and aquatic habitats that may be affected by future bank protection projects.	State and local flood control agencies

Location	Guideline		Responsibility
Entire corridor	**BP5**	Avoid activities that diminish the stability and effectiveness of existing bank protection in areas where new bank protection works are not to be constructed.	State and local flood control agencies

Guidelines for a Levee Protection Area

The Sacramento River levees were originally constructed in the late nineteenth and early to mid-twentieth centuries. The historical foundations of these levees may be composed of weak and permeable sand and silt. Some of the older levees were incorporated into the state/federal levee system when it was first established. However, many of these older levees do not conform to more stringent, modern levee construction standards such as minimum levee slopes and widths, minimum engineered compaction of the internal levee foundation, and resistance to seepage.

The demands of flood-fighting techniques and the spatial requirements for raising, setting back, or widening weak levees in future years necessitate a prudent avoidance of building structures near levees that prevent these activities, or contribute greatly to the risk or cost of measures to prevent flood disasters from occurring. Establishing levee protection areas and protective guidelines applicable within these areas leads to reduction of flood risk, especially for floodplain basins surrounded by levees of uncertain internal and sub-surface conditions.

The state water code calls for a minimum levee slope of 3:1 on the waterside, and 2:1 on the protected side of the river, with a minimum top width of 20 feet and an additional, landside easement of 10–20 feet beyond the levee toe (see Figure 2, “Flood Protection Zones across the Floodway”). These minimum levee standards have unfortunately become the norm for present-day levees protecting urban areas, instead of promoting urban levees that comfortably exceed bare minimum standards. Yet the current standards were first written into the water code when the state-federal flood control system protected primarily undeveloped agricultural lands. These minimum levee standards have proven to be an inadequate template for the reliability of stable levees (note concerns shown on Figure 3).

New technologies and expanded geotechnical and geomorphic studies of regional levee conditions strongly suggest that underlying and unknown levee conditions call for a new, hard look at how to ensure the safety and reliability of the levee system in the event of a major flood event, such as occurred in 1986 and 1997. During high stage in the river, seepage through and under porous levees has been found to occur within a distance of up to 400 feet from the landside levee toe (see Figure 4). In some cases, the seepage effect has weakened or threatened the stability of affected levees and necessitated costly repairs and upgrades. Seepage conditions from flood stage in the river have also flooded and damaged foundations of structures near the levees and increased demand on the pumping capacity of local drainage districts and infrastructure.

A common structural repair of "leaky levees" requires construction of a berm on the landside of affected levees, extending 50 feet to several hundred feet landward of the levee and several feet thick. Such a berm is designed to resist accumulated water pressure while safely releasing seepage water. Where structures are present in a seepage-affected area, there are fewer possible design alternatives for preventing seepage-caused levee failure, and the remaining design solutions are considerably more costly (e.g., levee-seepage-cutoff deep trenches, back-filled with a cement/clay slurry, up to 80 feet deep).

FEMA has enacted new and more rigorous levee stability criteria and geotechnical evaluation that must be met to certify that local levees meet a 100-year level of protection from flood disasters. The state Reclamation Board considers these and other levee stability and geotechnical safety standards when they review projects before issuing permits for levee or floodway encroachments.

Implementation of the following levee protection (LP) guidelines will greatly reduce the uncertainty and risk associated with poorly understood conditions within and below levee foundations, or the often unpredictable occurrence of a local levee failure or near-failure. The LP guidelines address two key issues: 1) the setting back of structures extending 50 feet from the landside toe of the levee, defining the minimum area needed for flood fighting and future levee repairs; and 2) conducting levee stability and geotechnical studies in conjunction with proposed projects to identify any potential underlying risks and repairs that may be needed prior to implementing the proposed projects.

Location	Guideline		Responsibility
Levee Protection Area as shown in Figure 13	**LP1**	Participating Forum agencies should designate a Levee Protection Area encompassing the footprint of the levee and an area extending 50 feet from the landside toe of levees (Figure 13). Local designation of Levee Protection Area boundaries can be through one of many venues, including an updated general plan, request for zoning changes, subdivision maps and PUDs, specific plan amendments, additions to local building codes, or other permitting procedures (see also guideline LP4). When levee segments show signs of imminent failure, such as occurred in 1986 along Garden Highway north of Sacramento, 50 feet corresponds to the minimum staging area needed to deliver and place substantial volumes of rock and earth using large trucks and heavy equipment. The Levee Protection Area will ensure that permanent buildings and residences will not be damaged or removed in the future when flood control agencies respond to levee weaknesses during major floods, or construct major levee repairs that often entail widening or realigning a levee segment on the landward side.	Land use and flood control agencies

Location	Guideline		Responsibility
Levee Protection Area as shown in Figure 13	**LP2**	The minimum setback distance for structures from the landside levee toe is 50 feet (see Figure 13). A 50-foot buffer is the experience-based, minimum distance needed to inspect, maintain, repair, upgrade, or flood-fight weakened levees during major floods. Site-specific exceptions to the 50-foot standard should be allowed only in cases where levee stability upgrades greatly exceed minimum standards (e.g., substantially widened levees or landside reinforcement berms as shown in Figure 7), such that risk and uncertainty are substantially removed at that location. This guideline is **not** intended to preclude productive public and private land uses and improvements within the setback zone, including minor or temporary structures (See LP4). However, levee roadway access and designated staging areas must always be maintained free of any obstructions (see Guidelines AR1 thru AR6, pages 3-17 & 3-18).	Regional and local flood control agencies
Levee Protection Area as shown in Figure 13	**LP3**	Allowing permanent structures within the critical 50-foot setback zone should require a thorough analysis of the potential levee failure modes in that location, correction of any identified deficiencies, documentation of necessary long-term operation and maintenance activities, and confirmation that all future remedial or maintenance activities can be carried out without being hindered by the proposed structures.. Examples possibly meeting this condition includes the existence of or improvement to an engineered, widened levee; a levee having greater than a 2h:1v landside slope and greater than 3h:1v waterside slope; or the existence or construction of a substantial landside reinforcement berm (see Figure 7).	Land use and flood control agencies
Levee Protection Area as shown in Figure 13	**LP4**	Appropriate land uses within the Levee Protection Areas could include public access facilities (such as riverside parks, open space/habitat, bike and pedestrian trails, restroom facilities, and other low-profile amenities), maintenance yards and parking lots, minor local streets, outdoor recreation complexes, and other non-structural public or private uses. For example, residential development plans could be designed to accommodate portions of the Levee Protection Area as dedicated open space, and enhance public access to and along the river by concentrating housing-related parks or nature areas and mitigation sites adjacent to the levee system.	Land use agencies and project proponents

Location	Guideline		Responsibility
Levee Protection Area as shown in Figure 9	**LP5**	Before permitting structures, excavations, rezones, or subdivision maps within or adjacent to designated Levee Protection Areas, local land use jurisdictions should require a levee stability and seepage geotechnical study (elements of study to be determined by local agency) to ensure that the levee in the vicinity of the proposed project has no conditions of concern with regard to stability or seepage, and is considered safe. For rural areas in which urbanization has been limited, state or federal assistance may be needed in order to complete such a study, as well as any needed repairs or upgrades. Results of geotechnical analysis of levee seepage potential may recommend significant structural improvements to local levee stability and reliability (see examples in Figure 7). Appropriate designs will vary based on the geotechnical evaluation, but reduction of identified risks (if any) typically requires improvements to be made on the landside of the adjoining levees. Landside levee improvement options may include seepage collection trenches, seepage barrier berms extending up to several hundred feet from the base of existing levees, raised or widened levees, landside buttress berms, relief well arrays along with water collection/pumping facilities, or even setting back the levee where waterside bank erosion threatens it.	Local land use and flood management agencies and project proponents
Levee Protection Area as shown in Figure 13	**LP6**	Although Guideline LP3 describes and stipulates project-specific geotechnical evaluations before permits are issued, local and regional jurisdictions and flood management districts in urban floodplain basins should consider comprehensive, basin-wide geotechnical studies, followed by repair and upgrades to weak or uncertain levees. A basin-wide study and levee remediation plan (e.g., SAFCA's Natomas basin geotechnical study and levee remediation plan) could precede or be conducted concurrently with issuance of new permits for urban development to ensure the safety of urbanizing basins (see discussion following LP7).	Land use and flood control agencies
Rural and agricultural sub-basins and unincorporated communities	**LP7**	The state Department of Water Resources, FEMA and the Corps should assist local land use agencies with funding and technical support for geotechnical levee stability evaluations through new legislation (e.g., State Assembly Bill 1665), designated funding mechanisms, or cost-share studies and repair projects. State and federal assistance is especially needed where local, agricultural reclamation districts and small rural towns are inadequately funded even to keep pace with routine levee maintenance demands and typically have no engineering staff. Rural communities, road networks, and other infrastructure are at risk if these agricultural basin levees fail.	State and federal flood management agencies

Existing metropolitan urban areas are contained primarily within urban sub-basins where geotechnical and bank stability studies already have been

conducted, and where substantial levee reinforcements and bank protection projects have been completed or are planned and in progress.

Where new or expanding housing subdivisions share a levee-protected basin with predominantly rural, agricultural land uses, the cost to implement Guidelines LP3 and 6 will likely be funded by in-progress and future housing and commercial developments. In some sub-basins, project-by-project geotechnical studies, and incremental levee repairs or upgrades may be a more realistic scenario than a basin-wide study and plan, unless new funding sources become available from the state or federal government.

Guidelines in the FMP anticipate the new and more rigorous FEMA standards for levee certification, reduced federal funding, and litigation liability concerns of DWR. Therefore, a new and expanded burden of responsibility is of necessity placed on local agencies to ensure that local levees and the river floodway within their jurisdiction protect their citizens and cities, and are consistent with state and federal regulations and guidelines for the flood control system infrastructure.

However, the state (DWR, Reclamation Board) and federal government (Corps, FEMA) have an ongoing responsibility to protect existing urban and rural communities that rely on state/federal flood control operations and the project levee and flood bypass system. State and federal cost-sharing and technical staff support for costly geotechnical studies and critical levee repairs and upgrades is essential to a local-state-federal partnership needed to modernize flood protection infrastructure and maintain its long-term reliability. State and federal assistance is especially necessary in rural areas where county governments have deliberately limited urbanization in order to protect local and regional agricultural land use.

Improved Levee and Floodway Maintenance and Road Access

Flood operations success entails the ability of local, state, and federal flood management entities to safely and thoroughly inspect, maintain, and operate (in the case of structures like flood gates and adjustable weirs) the flood control infrastructure at all times of the year and under all weather conditions, including flood events. In addition, flood operations require an unencumbered levee roadway and sufficient staging areas to conduct emergency flood fights at unpredictable times and locations during high-water-stage events. Flood fighting includes unscheduled, often high-risk activity such as waterside operation of large construction equipment; debris removal at vital structures during floodflows; dumping of large rock masses to thwart bank erosion; emergency reinforcement of weakened structures; and rescue operations.

The continuity and condition of the levee roadway are the most essential components of a workable flood operations program, whether for emergency repairs or to conduct routine inspections and maintenance. Figures 14 through 17 show the general condition of levee roads along the Sacramento River corridor.

Additionally, the levee roadway in combination with adjacent roadways and other features such as parks, trails, and boat ramps allows public access to the floodway. The following overall guideline, previously presented under "Overall Floodway Planning and Design Guidelines," expresses the desire to balance the need for improved flood protection and public access.

> *Incorporate public recreation and access facilities into the river corridor, particularly as a part of new development and flood control projects, to provide continuous access to and along the river, to the maximum extent feasible.*

Therefore, the Forum advocates the following guidelines be incorporated into area-wide planning and project approval processes for all current and future projects in the Sacramento River corridor.

Guidelines for a Continuous Levee Roadway

The goal of the Continuous Levee Roadway guidelines is to improve the conditions and continuity of levee roadways to ensure prompt and unhampered flood-fight access for flood control agencies. Barriers, such as bollards or locked gates across levee tops, make it difficult and time-consuming for flood control agencies to take emergency flood-fight actions. Other impediments to timely flood-fight response include unpaved or narrow levee roads and insufficiently spaced vehicle turnouts, as the equipment generally used during flood fights includes large rock trucks with trailers and heavy grading equipment. Improved levee roadway continuity may also have public access benefits where compatible with ownership and land use. The recommended guidelines for a continuous levee roadway (LR) are:

Location	Guideline		Responsibility
Entire corridor	**LR1**	Barriers and gaps between discontinuous segments of the levee road system should be removed and eliminated. Flood management crews and vehicles should have safe, uncluttered, and time-efficient access to the levees flanking the river from all surrounding urban and industrial streets, with as few locked gates and bollards as are reasonable to control unauthorized private vehicle access where necessary. Public access should be provided consistent with this guideline to the extent feasible.	Landowners and flood control agencies
SRMP area	**LR2**	Planned river greenway or parkway areas, including promenades, and levee roads in the SRMP area should be designed to accommodate use of large, emergency vehicles (e.g., fire and rock-hauling trucks) with minimal damage to the levee.	Flood control agencies and/or local and state transportation authorities
Entire corridor	**LR3**	As a general guideline, levee-top conditions throughout the corridor should allow the safe passage of maintenance and inspection vehicles. (For example, Title 23 requirements typically stipulate a minimum levee road crown width of 20 feet.)	Flood control agencies and/or local and state transportation authorities

Location	Guideline		Responsibility
Entire corridor	**LR4**	Periodic access points or vehicle turnouts should be provided at 2,500-foot (or shorter) intervals in developing areas. This guideline will significantly improve the existing level of vehicle access for inspection and routine maintenance in those portions of the river corridor where industrial sites or urban structures have inadequate intervals of access. Access points or regularly spaced vehicle turnouts (i.e., having a total levee or roadway crown width of 50 feet or more) will also ensure that emergency work crew vehicles, grading equipment, and large rock trucks with trailers can safely negotiate two-way routes when flood circumstances demand it and will provide safer public access during the rest of the year. This effort may require state and/or federal funding assistance in more rural areas.	Flood control agencies and/or local and state transportation authorities

Guidelines for Good Access to Levee Roads

The purpose of the Good Access to Levee Roads guidelines is to improve road conditions in order to reduce the difficulty of levee O&M activities. In areas where no paved levee roads exist for vehicles, infrequent road connections to levees and locked gates or bollards at access points often make even routine levee maintenance activities difficult. In many locations along the Sacramento River corridor where paved levee roads do exist, high vehicle speeds and heavy traffic along levee roads combined with restrictive guardrails and a dearth of wide turnouts make it difficult for flood maintenance agencies to maneuver equipment and conduct low-speed inspections. The following guidelines for good access to levee roads (AR) recommend access and traffic design and management options to allow levee-maintaining agencies to conduct O&M without posing a safety risk to maintenance staff or the public.

Location	Guideline		Responsibility
Entire corridor	**AR1**	For emergency vehicle access and heavy equipment, there should be suitable access ramps or connections to the levee roads from city streets at 2,500-foot (or shorter) intervals.	Project proponents, flood control agencies, and/or local and state transportation authorities
Entire corridor	**AR2**	Locked gates or bollards at access points must be approved by the local levee system–maintaining entity, and consistent with detailed specifications and standards contained in Title 23 state regulations under the jurisdiction of the Reclamation Board.	Landowners and project proponents in conjunction with flood control agencies
Entire corridor	**AR3**	Design should provide for adequate floodway construction staging areas for rock trucks and heavy equipment at suitable intervals not to exceed 1 mile along the levee roads. Large vehicle turnouts may suffice for these purposes, as determined by the local levee system–maintaining entity.	Landowners, project proponents, local planning agencies, flood control agencies, and/or local and state transportation authorities

Location	Guideline		Responsibility
Outside SRMP area	**AR4**	Levees that support public roadways should be widened where feasible to better accommodate increased traffic, guardrails, and maintenance vehicles.	Flood control agencies
Outside SRMP area	**AR5**	In association with local or regional development projects, local and state transportation authorities should consider directing vehicles to existing non-levee roads or constructing new non-levee roads to accommodate increasing traffic volume in developing areas. This effort may require state and/or federal funding assistance in more rural areas.	Local and state transportation authorities
Outside SRMP area	**AR6**	Local and state transportation authorities should coordinate with land use planners and implement measures to ensure that increased traffic associated with existing and new communities in developing areas does not unreasonably burden levee roads or levee O&M procedures. Possible measures include reliance on existing non-levee roads, construction of new non-levee roads, and expansion of levee roads consistent with flood control, habitat, and public access needs. This effort may require state and/or federal funding assistance in more rural areas.	Local and state transportation authorities in conjunction with local planning and flood control agencies

Guidelines for Multiple-Use of Levee Roads and Trails

As discussed above in the Overall Floodway Planning and Design Guidelines, the goals of the FMP include improved ability of flood control agencies to conduct levee maintenance and flood-fight activities as well as the incorporation of public recreation and access facilities into the river corridor. Facilities and management actions for both activities need to be planned in concert with one another, and a growing population in the Sacramento area means that the existing level of use of levee roads and access facilities by the public will only increase. Public walkways and roads, when designed to accommodate levee maintenance and flood-fight activities, can benefit and improve the flood control functions of the system. The following guidelines for multiple-use of levee roads and trails (MU) present strategies for successfully and safely accommodating both public use and levee maintenance operations on levee roads.

Location	Guideline		Responsibility
Entire corridor	**MU1**	Levee roads should maximize use and access to river amenities and views by the general public, consistent with ensuring that levee road and floodway functions are not jeopardized and that rights of access are not abused. New facilities should accommodate public use and access.	Transportation authorities and agencies providing public access

Location	Guideline		Responsibility
Entire corridor	**MU2**	Public trails and promenades that share levee roadways shall be constructed with all-weather materials that allow people and bicycles to safely avoid and pass maintenance and inspection vehicles. (Note also that Title 23 includes this requirement; other specific permit conditions may apply.)	Local planning agencies
Entire corridor	**MU3**	Multi-use roads can be single-lane where crown width does not allow for two-way lanes. In these cases, adequate turnouts and access points for rock trucks and emergency equipment should be provided at least every quarter-mile interval for safe passage and levee maintenance parking. Improvements are contingent on acceptable cost-sharing agreements among local, state, and federal entities.	Transportation authorities in concert with flood control agencies
Entire corridor	**MU4**	Informational signs should be posted along all multi-use levee roads that explain the rules for shared use and flood safety. Signs should explain the need for the appropriate flood management entities to temporarily close levee roadways to the public during flood emergencies. (Note also that Title 23 includes this stipulation; other specific permit conditions may apply.)	Entities responsible for the various uses
Entire corridor	**MU5**	Flood management entities are not responsible for damage to multi-use trail pavement or other features that must be removed to conduct effective and safe flood-fight repairs to levees or critical public infrastructure (e.g., bridge abutments and utility bulkheads) or to stabilize weakened riverbanks. (Note also that Title 23 includes a similar stipulation.)	Project proponents and local agencies
Entire corridor	**MU6**	When flood management entities acquire property or easements for floodway projects, their acquisition should provide public access easements along levee segments where public-use amenities are planned within the corridor, contingent on an acceptable cost-sharing agreement between responsible agencies. Private property owners and other affected parties should be participants in the negotiations, and their liability limited.	Flood control agencies
Outside SRMP area	**MU7**	Local and state transportation authorities should coordinate with flood control agencies and together identify effective traffic control measures and/or provide traffic control equipment to facilitate safe levee O&M and flood-fight activities.	Transportation authorities in conjunction with flood control agencies
Outside SRMP area	**MU8**	Local and state transportation authorities should coordinate with levee maintenance agencies to ensure that existing and future roadway features such as guardrails are located and designed in a manner that accommodates essential levee maintenance work.	Transportation authorities in conjunction with flood control agencies

Location	Guideline		Responsibility
Outside SRMP area	**MU9**	Preventive road maintenance programs and preventive levee maintenance programs should be used in a coordinated fashion throughout the system to minimize threats to public safety and the flood control system and allow sharing of equipment and financial resources where appropriate. This will also help to minimize the extent and duration of traffic disruptions.	Transportation authorities in conjunction with flood control agencies
Outside SRMP area	**MU10**	Where new development or transportation system infrastructure is planned, the following priorities should guide plans for roads associated with levees: 1. Remove public arterial roads from levee crowns, or substantially widen such levees to accommodate parallel use (i.e., not overlapping) for both major transportation corridors and for levee maintenance and access lanes and parking. 2. Reduce transportation use on levee crown to local traffic, maintenance and agricultural vehicles, and river access. 3. Widen levee to provide 10-foot shoulders for equipment access and to obviate the need for guardrails. In combination with 2 and 3 above, provide signage at regular intervals that warns drivers about working crews, and enforce reduced speed limits when maintenance activities are in progress.	Transportation authorities in conjunction with local land use and flood control agencies

Guidelines for Public Access

Currently, public access facilities throughout the Forum study area are scattered and often do not meet local or regional needs. The existing facilities were designed on an individual basis, often without regional coordination. In some areas, commercial and residential riverfront developments exclude or do not allow adequate public access to the river, and in other areas, disparate and uncoordinated forms of public access create conflicts among recreation, flood control, and habitat interests. Conflicts include inadequate parking facilities, resulting in dangerous traffic situations and degradation of levee crowns; inadequate control features or trail systems, resulting in habitat degradation and inappropriate use of private property; and use of areas that are not regularly patrolled or maintained, resulting in various illegal activities that create unsafe conditions, substantial litter, or a reluctance to provide legitimate public access.

As stated above in the Overall Floodway Planning and Design Guidelines, an underlying goal of the following guidelines is to encourage consistent and complementary incorporation of public recreation and access facilities into the river corridor to provide continuous access to and along the river, to the maximum extent feasible. "Continuous access" would connect various elements of physical or visual access to the water's edge. Public access, if designed properly, can be a compatible and complementary use with levee O&M and flood-fight activities, and increasing public access points would also increase

access for levee O&M and flood-fight activities. Public access proponents involved in the Forum have indicated that there is a growing demand among local citizens for a continuous, all-weather bicycle and pedestrian trail along the Sacramento River that could be used for commuting as well as recreational activities, with amenities such as rest areas with tables, restrooms, water fountains, and bike racks.

The first four public access guidelines address appropriate design and siting of public access features in the river corridor. Opportunities for increased public access to the river corridor are explored in the Levee Protection Area guidelines above. The implementation strategies and recommended actions discussed in Section 4 of this document address regional planning for public access facilities, the linkage between public access and commercial and residential development, and coordination among agencies and public access interest groups. The guidelines for public access (PA) are:

Location	Guideline		Responsibility
Outside SRMP area	**PA1**	Improvements to or construction of new flood control facilities outside the SRMP area should be designed and constructed to enhance public access to the maximum extent feasible.	Local planning agencies and flood control districts
Outside SRMP area	**PA2**	Parking for designated recreational access points outside the SRMP area should be limited to areas where it is safely accommodated and does not damage public infrastructure (e.g., roadways or levees), private property, or sensitive natural resources. Consider making parking areas for fishing access visible from the fishing spots.	Project proponents and local planning agencies
Outside SRMP area	**PA3**	Access for specific recreational activities outside the SRMP area, including boat ramps, and fishing in areas known as successful fishing spots, should be concentrated at a smaller number of formal sites with appropriate facilities, maintenance, and safety elements. The facilities should be designed to cater to the needs of the majority of expected users. In limited cases it may be appropriate to control existing public access where there are inadequate facilities and maintenance capacity, resulting in unsafe conditions or destruction.	Local planning agencies
Outside SRMP area	**PA4**	Public parking facilities should be designed to accommodate existing and future needs while minimizing conflicts with roadway users, levee O&M, and flood response activities. If designed properly, public parking facilities also could serve as levee O&M and floodfight staging areas.	Project proponents and local planning agencies
Outside SRMP area	**PA5**	Commercial riverfront development projects and modifications to existing commercial riverfront facilities should be designed to embrace public access. Commercial riverfront development should enhance rather than reduce public access opportunities.	Project proponents and local planning agencies

Location	Guideline		Responsibility
Outside SRMP area	**PA6**	Residential development should be designed to enhance public access to the river by concentrating local and regional open space and parks adjacent to the river. Additional possibilities are described in the Guidelines for the Levee Protection Areas.	Project proponents and local planning agencies
Outside SRMP area	**PA7**	Public access improvements should be coordinated with the appropriate agencies to ensure that public access projects: (1) are compatible with and complement other public access projects in the area, (2) conserve or enhance natural resources, (3) minimize public safety concerns, (4) maximize public benefit from the use of limited financial resources, and (5) do not impede or damage flood control efforts.	Project proponents and local planning agencies
Outside SRMP area	**PA8**	Public trails provided as part of new riverfront development should be located on the river side of private structures and provide access for flood control operations.	Project proponents and local planning agencies
Entire corridor	**PA9**	Where public access encourages people to trespass on private property, public signage, law enforcement, and limited private liability should minimize private trespass. Where public access to levees is impossible without using private property, landowners should be compensated for providing the public easement, receive legal protections to limit private liability, and compensated adequately for negative impacts.	Project proponents and local planning agencies

Ensuring Floodway Hydraulic Capacity and Function

Floodway capacity during a major flood event depends on a combination of predictable and difficult-to-predict hydraulic and structural characteristics, including channel geometry, sediment transport, roughness, debris transport and trapping, water surface elevation, bank and levee height, bank and levee stability, and integrity of structures in the floodway.

The current standard for hydraulic capacity is based on the 1957 design flood plane (1957 design water surface profile) as developed by the U.S. Army Corps of Engineers and regulated by the Reclamation Board. FEMA standards also apply. Both of these standards are considered to be minimum standards. An urban design standard for the Sacramento metropolitan area presented below will increase the level of flood protection for urban areas beyond that provided by the 1957 design water surface profile and current FEMA standards,.

Floodway hydraulic capacity and function are addressed from a system-wide perspective in two categories within this section. First, they focus on design parameters providing a level of flood protection adequate for the City of Sacramento and the City of West Sacramento. The outcome is a set of guidelines that recommend appropriate levee heights and amounts of freeboard within the study area. Second, floodway hydraulic capacity and function focus on the

effects that floodway encroachments have on water surface elevations and river channel velocities. The hydraulic guidelines recommend measures to limit cumulative impacts from floodway encroachments and improve levee and bank stability, debris passage, and structural integrity.

Guidelines for Hydraulic Capacity Design Parameters

While there are several design parameters that are essential to maintain a high level of flood protection and adequate hydraulic capacity, a key parameter is levee height. The current standard for levee height within the Sacramento River Flood Control Project is based on a water surface profile standard developed by the Corps in 1957, corresponding to the Corps design capacity of the levees and floodway channel at that time. Typical design levee height in 1957 provides 3 feet of freeboard above the design water surface profile on levees flanking the Sacramento River and 6 feet of freeboard on bypass system levees. The 1957 design profile was originally based on records of two historical floods and does not represent a specific return interval (e.g. 100-year flood). The level of protection provided by the 1957 design profile varies throughout the Sacramento and San Joaquin levee system. The amount of freeboard, or the vertical distance between the maximum water surface and the top of the levee, is an important factor in maintaining hydraulic capacity. Freeboard is relied on to provide adequate protection from wind and wave run-up during flood events, saturation of a road on top of a levee (system-wide, these are mostly dirt or gravel), and to accommodate for uncertainty associated with estimated water surface elevations or long-term hydrologic changes.

The Reclamation Board generally relies on the 1957 design profile to regulate projects as they relate to levee height.

There is an emerging state-wide strategy to increase the level of flood protection throughout the Sacramento and San Joaquin Valleys, including the establishment of a water surface profile for an urban standard of protection from a 200-year flood. Appropriate levee height and width, freeboard, stability, and under-seepage and erosion protection standards would be developed based on this urban standard flood profile.

Through its numerous efforts to increase the level of flood protection for the Sacramento region, SAFCA has conducted several evaluations of various elements of the Sacramento River Flood Control Project. As an integral part of these efforts, MBK Engineers has prepared several hydraulic modeling studies to predict water surface elevations under various scenarios of flood simulations. These hydraulic modeling studies provide the information necessary to develop an urban design standard.

The base computer model used for the urban design standard analysis is a UNET model, initially developed by the Corps for the Sacramento and San Joaquin Rivers Comprehensive Study and subsequently updated and recalibrated by MBK Engineers using information from the January 1997 flood event (MBK Engineers 2003). The model includes the Sacramento River from Collinsville

(River Mile [RM] 0) to Woodson Bridge (RM 218), the lower reaches of major tributaries, and the Sutter and Yolo Bypasses. The water surface elevations produced by the model are the basis for determining appropriate levee heights capable of meeting the urban design standard.

The urban standard flood elevations for the Sacramento region were produced based on the following key assumptions:

- 200-year flood event with Folsom Dam Modifications in place, and limiting reservoir releases to the lower American River to 160,000 cfs flow (the 1986 flood peaked at approximately 138,000 cfs);
- Upstream levees that do not meet the 1957 design profile are assumed to be improved to meet that standard, thereby containing and passing peak flows downstream; and
- Upstream levees that may overtop during future high flows predicted by the model **do not breach** (overtopped levees often cause levee breaches which quickly erode and widen the opening by several hundred feet. Compared to overtopping flow, a levee breach greatly increases the amount of river flow leaving the channel and entering the adjacent floodplain. Therefore, breached levees inadvertently lessen flood risk downstream of the breach.).

These conservative modeling assumptions have been agreed to in principle by the staff of SAFCA, the City of Sacramento, and the City of West Sacramento.

While the same base model is also used to analyze cumulative effects of floodway encroachments, described below under "Guidelines for Hydraulic Analysis and Monitoring", certain assumptions used in the modeling differ between the two analyses. In particular, the modeling for the urban design standard assumes that modifications to Folsom Dam that are currently underway or planned are in place. The modeling for the cumulative encroachments in the Forum's river corridor and SRMP reach conservatively assumes that the modifications to Folsom Dam are not in place. The reason for this difference is that the urban design standard requires a reasonable numeric result that will guide the design of future, long-term levee improvement projects, while the cumulative encroachments analysis was intended to conservatively estimate the sensitivity of flow in the floodway to hypothetical future encroachments (e.g., more marinas, bridges, private docks, shoreline vegetation, and river access structures, etc.).

Since a system wide standard for a higher level of flood protection (e.g., urban design standard) does not yet exist, an analysis of system wide impacts is necessary for local projects. Ultimately, the FMP's urban design standard should be based on a peer-reviewed, 200-year flood surface profile as determined by the Corps, and subsequently used as a system wide regulatory standard for levees and floodways. The Corps has not completed a new, updated system-wide model, and there is currently no schedule for model completion and release for use by the Reclamation Board. In the interim and short term, riverside urban projects will use the SAFCA/MBK model results as a basis for design of projects underway in the FMP planning area.

The guidelines listed below for hydraulic design (HD) focus on implementing an urban design standard that provides an adequate level of flood protection to areas protecting urbanized land use in the Forum's FMP planning area.

Location	Guideline		Responsibility
Urban areas	**HD1**	Adopt an urban design standard, which is generally representative of an estimated 200-year level of protection, as a basis for determining appropriate levee heights and freeboard in urban areas.	Flood control agencies and local land use authorities
Urban areas	**HD2**	Freeboard shall be maintained at 3 feet above the urban design standard water surface elevation for levees with typical dimensions to avoid levee failure due to overtopping. Freeboard may be reduced to no less than 1 foot above the urban design standard water surface elevation for high ground if the width of the high ground beyond the waterside top of bank exceeds 300 feet and the landside slope does not exceed 10% within an additional 700 feet (see Figure 11). Freeboard may be reduced to no less than 1 foot above the urban design standard water surface elevation for oversized levees if the oversized levee is designed to provide: 1) adequate protection for wave run-up and wind setup; 2) adequate protection of landside slopes that prevent failure due to overtopping; 3) no less than 3 feet of freeboard above the Corps' 1957 design profile; 4) adequate protection from potential seepage effects to buried utilities or underground structures; 5) paved surfaces over all or most of the width of the 35 foot setback area and road on top of the levees; and 6) the width of the crown of the oversized levee is 50 feet or greater.	Flood control agencies and local land use authorities

Guidelines for Hydraulic Analysis and Monitoring of Floodway Encroachments

Facilities such as bridges, docks, in-channel marinas, bank protection, and revegetation projects constructed within the floodway may have incremental effects on hydraulic capacity. These physical changes primarily affect the margin of the channel, and when the facilities are properly designed the effects are generally small and may occur only in the local area of the facility. However, the potential for construction of a significant number of facilities leads to concern over cumulative hydraulic impacts. An evaluation of potential cumulative impacts was conducted at the request of SAFCA (MBK Engineers 2005) using a one-dimensional (1-D) hydraulic model. MBK's hydraulic impact analysis report can be found in Appendix E of this document.

As previously described, the base model used for the cumulative analysis is a UNET model, initially developed by the Corps for the Sacramento and San Joaquin Rivers Comprehensive Study and subsequently updated and recalibrated by MBK Engineers using information from the January 1997 flood event (MBK Engineers 2003). The model includes the Sacramento River from Collinsville (River Mile [RM] 0) to Woodson Bridge (RM 218), the lower reaches of major tributaries, and the Sutter and Yolo Bypasses. The potential future hydraulic effects of floating docks, in-channel marinas, bank protection projects, and changes in vegetation were estimated using a hypothetical set of changes in the floodway and conservative assumptions regarding their hydraulic effects.

The evaluation included the following changes in the floodway:

- Five new bridges (43rd Avenue, Broadway Extension, R Street pedestrian, Richards Boulevard pedestrian, and San Juan Road). *NOTE: Two proposed off-channel marinas located in the SRMP area (Stone Locks and Lighthouse Marina) would have no affect on floodway hydraulics because they would be placed in a slack water location outside the functional floodway. Therefore they are not included in the hydraulic modeling analysis.*
- New, densely developed boat docks and fishing piers in three areas (east bank of Pocket area; west bank in West Sacramento; and east bank of Natomas area). Continuous dock lengths of approximately 6 miles, 2.5 miles, and 5 miles were used in these three areas, respectively. The exaggerated assumption made in the model about continuous docks (an unlikely condition) is intended to determine hydraulic sensitivity of this reach under worst-case conditions.
- Five new in-channel marinas (near Clarksburg, Freeport, RM 56, San Juan Road, and where Interstate 5 (I-5) crosses the Sacramento River.
- Riparian vegetation enhancement on both banks of the river in the reach between Stone Locks and the American River, consistent with preliminary information for the SRMP.
- Rock bench bank protection with designs similar to the Corps-state-SAFCA sponsored project constructed in 2004 at RM 56.7 of the Pocket Area.

The hypothetical set of new bridges, docks, and fishing piers was modeled by blocking out the conveyance area of the channel associated with the entire hydraulic area potentially affected by these facilities. For the boat docks and fishing piers, a continuous blockage along the riverbank was assumed for the lengths listed above and typical widths derived from inspection of aerial photographs of existing facilities. The blockage associated with rock bench armoring was assumed to be included in these effects because the design template for RM 56.7 has a smaller projection into the river channel than that assumed for docks and fishing piers.

The marinas and riparian vegetation enhancement were modeled using estimated increases in hydraulic roughness ('n' value) associated with these changes. The marinas were assumed to have a length along the bank of approximately 1,200 feet and to extend into the channel about one-third of the channel's width.

The complete set of modeling assumptions is considered a conservative and relatively simple way of modeling potential cumulative impacts on a large scale. Details of the modeling assumptions are included in the appended report on modeling results by MBK Engineers (February 2005), prepared for SAFCA and to inform Forum discussions of hydraulic issues.

Potential cumulative impacts were assessed using two major floodflows:

- January 1997 Flood, an actual major flood event with good documentation of river stage and measured flows over time.
- "Maximum Flow" event (hypothetical worst-case flood event), defined as the 100-year event on the Sacramento River and 200-year event on the American River, assuming that levees upstream of the project area would not fail if overtopped.

The results of the hydraulic analysis estimate a maximum impact on stage downstream of the American River of 0.07 foot in the 1997 Flood event and 0.05 foot in the Maximum Flow event. Upstream of the America River, the maximum impact on stage occurs near I-5 and is estimated at 0.2 foot for the 1997 Flood event and 0.15 foot for the Maximum Flow event. The effects on river stage are minimized by slight increases in diversions to the Yolo Bypass at the Sacramento and Fremont Weirs. For example, in the 1997 Flood simulation, approximately 1,400 cubic feet per second (cfs) less flows downstream in the Sacramento River at the latitude of Sacramento, and approximately 1,400 more flows in the Yolo Bypass. Because the increase in flow in the Yolo Bypass is small compared to the total flow (0.3%), the computed increase in water surface in the Yolo Bypass is very small (0.03 foot). Similar effects occur in the Maximum Flow scenario.

Downstream of the Sacramento Weir, the cumulative impacts on flood stages are not considered significant. Upstream of the Sacramento Weir, the cumulative effects are slightly greater, and the capacity of the channel relative to the two flood scenarios is less. In the 1997 Flood simulation, the computed water surface profile encroaches into the minimum freeboard in the area between RM 73 and RM 79. In the Maximum Flow scenario, the computed profile is at or slightly above the levee crest at several locations in this area. Therefore, the cumulative impact analysis does not support additional floodway encroachments (e.g., floating docks, in-channel marinas) upstream of the Sacramento Weir without more detailed analysis or future flood control system improvements that effectively restore the minimum 3-foot-freeboard safety standard.

Computed maximum velocities increase up to 8% in both flow scenarios. Maximum velocities (averaged in the model across channel width and depth) in the project area increase from about 6.5 to 7 feet per second in the 1997 Flood event, and from about 7 to 7.5 feet per second in the Maximum Flow scenario. These increases are less than 10%, but may be significant in some situations at specific sites where they could induce additional bed scour or bank erosion. However, the results of this analysis are intentionally overly conservative as a result of using complete blockages to represent some facilities where some flow-through is a more realistic expectation. Under actual channel flow conditions,

flow velocity will vary considerably between the left and right bank, with the highest velocity typically found in the center of the channel, or closer to the bank on sharp outside bends.

The 1-D UNET model will be used for evaluation of potential changes in the project area after the Corps of Engineers and Reclamation Board complete a review of the cumulative hydraulic impact analysis. The model will be updated as new information becomes available and changes occur. Where more detailed assessment is required of local hydraulics or changes in velocity distributions in the channel, 2-D (two-dimensional, with greater detail about local hydraulic effects) modeling may be used. In this case, the 1-D model will be used to provide boundary conditions (magnitude of floodflows entering and exiting the modeled section of river) for the more detailed, local analyses.

The guidelines listed below for hydraulic analysis and monitoring (HM) focus on maintaining or improving existing overall hydraulic capacity and improving the predictability of flood control system performance. Predictability is improved by limiting facilities to those that have been demonstrated not to have cumulative impacts on the floodway; by implementing guidelines that improve levee and bank stability, debris passage, and structural integrity; and by implementing inspection and monitoring programs.

Location	Guideline		Responsibility
Entire corridor	**HM1**	Use and update the baseline 1-D hydraulic model to evaluate hydraulic effects. Maintain the modified 1-D UNET model (or approved HEC-RAS successor) as the standard tool for analysis of project effects in the Forum's 50-mile reach of the Sacramento River, using the 1997 Flood and Maximum Flow scenarios. SAFCA will make periodic updates and maintain the model, with Corps and Reclamation Board support, to reflect technical corrections, new information, and significant changes in the floodway. The complete model and a simplified version for the Forum planning area will be available for use by all agencies, subject to guidance on appropriate use of modeling methods and assumptions for input parameters.	State and local flood control agencies
Entire corridor	**HM2**	Conduct additional, detailed modeling of facilities as they are proposed at the conceptual or preliminary design level. Use 2-D model simulations to assess the local effects of proposed facilities with significant physical encroachments into the floodway when: (1) the proposed facility may have effects on bed or bank stability attributable to changes in flow or velocity distribution; and (2) the proposed facility may have interactive or cumulative effects with other existing, proposed, or planned facilities. This modeling will provide information on localized effects at the project site. The 1-D model will be used to provide boundary conditions for the local 2-D model.	Project proponents and state and local flood control agencies

Location	Guideline		Responsibility
Entire corridor	**HM3**	Conduct detailed local modeling of proposed new marinas. In-channel marina facilities that are consistent in location and configuration with the cumulative impact analysis may be considered without additional cumulative impact analysis. However, detailed 2-D modeling or other analysis will be required to assess local effects, such as changes in velocities, sediment deposition, accumulation of floating debris, and bank stability. Adverse local hydraulic effects will require mitigation measures or redesign of the project.	Project proponents and state and local flood control agencies
Entire corridor	**HM4**	Reduce modeling requirements for projects consistent with the cumulative impact analysis. Relatively minor shoreline projects, such as vegetation restoration, small private docks, terraces and trails, and bank protection benches that are consistent with the assumptions and results of the cumulative hydraulic impact analysis, should not require additional modeling. However, modeling may be required to develop design parameters for the proposed facilities, and model input information may be required to facilitate periodic updates of the baseline model by SAFCA. For large-scale shoreline projects, or projects that are a new type or orientation or located differently from the assumptions of the cumulative analysis, use of full 1-D and 2-D models is likely to be required.	State and local flood control agencies
Entire corridor	**HM5**	Monitor large flood events to collect data for hydraulic model calibration and evaluation of bank and bed stability. For events with stages greater than 25 feet at the I Street gage, measure and record high water marks, and conduct post-flood inspections to identify erosion sites and debris accumulations and to check the integrity of floating structures and access facilities.	State and local flood control agencies
Entire corridor	**HM6**	Conduct channel surveys on 10-year or shorter intervals to update model bathymetry and monitor changes in bed elevations.	State and local flood control agencies
Entire corridor	**HM7**	Conduct an annual low-water survey to photo-document bank conditions and map areas of erosion.	State and local flood control agencies
Entire corridor	**HM8**	Create a shared database for maintenance of channel monitoring information.	State and local flood control agencies
Entire corridor	**HM9**	Conduct bank and bed stability evaluations for projects that include in-channel structures or modifications of channel or bank geometry. Include analysis of existing and proposed hydraulic conditions, historical bank stability, existing bank protection, bank condition and susceptibility to erosion, and potential for local turbulence, wave generation, or other conditions that may induce erosion.	Project proponents and state and local flood control agencies
Entire corridor	**HM10**	Improve existing conditions, where feasible, at sites that have in the past or may trap or create flood debris or induce sediment deposition.	Project proponents and state and local flood control agencies

Guidelines for In-Channel Structures

Floating and in-channel riverfront structures are valued as a public connection to the waterway and for the riverside amenities they afford. The closeness of these facilities to the water serves to promote public awareness of the region's waterways and to enliven urban waterfronts. Floating restaurants, fishing piers, and guest docks, in designated locations, are an important component of the SRMP approved by the cities.

However, floating and in-channel structures may cause increased drag or hydraulic resistance that may affect local hydraulics or sediment deposition. They also may increase potential for accumulation of floating debris, which may cause an increase in hydraulic resistance reduced velocities, leading to sediment deposition in the channel around the structures. Poorly secured floating structures pose a concern because of the potential to break away and become impinged on downstream or other infrastructure. This in turn may cause river flow to be blocked, resulting in higher water surface elevations upstream, or redirected, increasing the potential for bank or levee erosion. Breakaway structures may also damage other facilities or critical infrastructure downstream. In-channel and floating structures may require installation of utilities and access ramps that may affect levee inspection, impede maintenance activities, restrict flood emergency operations, hinder effective repair, or exacerbate debris accumulation. Access by the public to floating or in-channel structures may be problematic or restricted because of hazardous conditions during a flood event.

The addition of in-channel and floating structures and public access facilities to the floodway complicates the job of flood management and levee maintaining agencies, potentially affecting access and visibility for inspections and repairs, increasing the cost of repairs, and increasing potential for conflicts with the public during both routine activities and flood emergencies.

For the purpose of these guidelines, in-channel structures are defined to include:

- buildings, whether floating or supported by piers or bank-side abutments on the water side of the levee;
- any structure encroaching on top of or against a levee;
- docks for transient mooring of boats; and
- other floating or pier-supported structures to accommodate fishing, viewing, marine services, industrial facilities, or passenger loading.

The following guidelines for in-channel and floating structures (CS) are recommended to avoid or minimize potential adverse effects on the floodway or its levees and to improve overall public safety and enjoyment of the natural river and public amenities. Note that the Reclamation Board, Corps, and State Lands Commission (SLC) has significant authority over, and require permits for the construction of in-channel and floating structures and associated facilities within the river channel. The Reclamation Board, Corps, and SLC should be consulted early in the planning process regarding the location and design of these features.

Location	Guideline		Responsibility
Entire corridor	**CS1**	Substantial floating or in-channel structures will be considered only if included as part of a locally approved riverfront master plan, such as the SRMP. The projects proposed in the plan will be subject to CEQA documentation and review by river and floodway permitting authorities and other affected agencies.	Land use agencies, state, regional, and local flood control agencies
SRMP area	**CS2**	SRMP jurisdictions will develop, in consultation with flood protection and resource agencies, construction guidelines, ordinances, or code requirements using best current practices and engineering analysis for the design and construction of in-channel and floating structures within the floodway or encroaching on the water side of levees. These requirements will address, but not be limited to, these issues: ▪ levees accessible to flood control and emergency vehicles and equipment; ▪ reliable anchorage in the channel bed or on banks and levees; ▪ effective debris deflection; ▪ automatic shutdown of utility connections and centralized shutdown switches or valves; ▪ temporary closure of riverside structures and other operating criteria for routine maintenance activities or during major flood events; ▪ periodic inspections of structures, access ramps, and anchoring systems; and ▪ other structural, building, flood protection, and navigation issues.	Cities of Sacramento and West Sacramento
SRMP area	**CS3**	Locate in-channel and floating structures to avoid or minimize impacts on nearby critical public infrastructure, including bridges and other major utilities such as city water intake facilities.	Land use agencies and project proponents
SRMP area	**CS4**	Configure in-channel and floating structures to avoid or minimize potential for debris accumulation. Structures should be designed to divert debris to the center of the channel or have debris deflectors located at their upstream end. Debris deflectors should be designed to resist potential impact forces and hydrodynamic loading from debris accumulation.	Land use agencies and project proponents
SRMP area	**CS5**	Designate selected locations as a part of a locally approved master plan and refine configurations for in-channel and floating structures, using appropriate hydraulic modeling techniques and engineering evaluations.	Land use agencies and project proponents
SRMP area	**CS6**	Limit the water-ward extent of in-channel and floating structures to maintain a safe channel width and configure structures to align with prevailing river navigation patterns.	Land use agencies and project proponents
SRMP area	**CS7**	Design the size, orientation to flow, and shape of in-channel and floating structures to avoid or minimize adverse, localized hydraulic effects, sediment deposition, and interruption of navigation patterns.	Land use agencies and project proponents

Location	Guideline		Responsibility
SRMP area	**CS8**	Provide engineered anchorage of in-channel and floating structures considering hydraulic impact forces from upstream breakaway structures and debris loading forces during major flood events.	Land use agencies and project proponents
SRMP area	**CS9**	Provide automatic shutdown for pressurized fluid and electrical systems if a failure or breakage occurs and provide centralized shutdown switches or valves at major access points.	Land use agencies and project proponents
SRMP area	**CS10**	Conduct periodic and post-flood inspections of in-channel and floating structures and their anchoring, access, and flotation systems to monitor for damage or weakness that may risk public safety during another flood event or cause bank erosion near levees.	Land use agencies, project proponents, flood control agencies
SRMP area	**CS11**	Restrict public and commercial use of in-channel and floating structures during major floods. Develop a set of operating criteria for existing and new in-channel and floating facilities that use river stage forecast information and public notification to prepare for and implement limited river access during major flood events. Inspect floating structures when the river stage is forecasted to rise to verify readiness for the expected flood event.	Land use and flood control agencies
SRMP area	**CS12**	Limit the water-ward extent of in-channel marinas and other floating structures to a maximum of 20% of the main channel width and configure the structure to align with (i.e., not obstruct) prevailing navigation patterns.	Land use and flood control agencies
Areas with approved riverfront master plan	**CS13**	Situate in-channel and floating structures to provide and protect lateral public access along the river and to avoid blocking views of the river from their landside.	Land use agencies, project proponents, flood control agencies

Marina Guidelines (SRMP Area)

In the context of the Forum guidelines, a distinction is made between full service marinas and comparatively smaller docks intended for public access, or as transient guest docks for boats or river shuttles (e.g., the River Otter fleet). A marina typically includes permanent year-round or seasonal dockage for a large number of mostly privately owned boats. Commercial marinas often require other permanent buildings and structures associated with boating support services such as a harbormaster headquarters, dry storage areas, eating or food sales facilities, fishing and boating supplies and equipment, launch ramps with trailer parking, mandatory waste tank pump-out stations, and maintenance and repair yards.

New marinas with permanent boat dockage and moorings in the SRMP area shall be sited **exclusively** in off-channel locations, outside the primary flow path of the floodway channel such as the Miller Park Marina and boat ramp.

Two additional off-channel marinas have been proposed within the SRMP area, one near the Stone Locks inlet to the Ship Channel terminus and the other at the uncompleted Lighthouse Marina site opposite the mouth of the American River.

The following Marina Guidelines (MG) are established to ensure that future new marinas in the SRMP urban core area do not contribute more encroachments to the floodway that expose people and property to additional risks during major flood events. Nor should new marinas contribute to the existing burden and challenge to safe navigation of river traffic, including the potential for breakaway boats and docks. New marinas will add more vessels to the existing traffic mix within the SRMP and beyond.

Location	Guideline		Responsibility
SRMP area	**MG1**	New marinas in the SRMP area shall be sited **exclusively** in off-channel locations,.	Land use agencies, project proponents, flood control agencies
SRMP area	**MG2**	Configuration of marina inlets should be analyzed and consciously designed to prevent the need for periodic dredging of river sediment and to prevent obstacles and hazards to navigation within the main channel. Appropriate 2-D hydraulic and sediment transport models will be required to verify that the new marina inlet design does not create new river sediment deposition sites demanding frequent sediment disposal, or that rock jetties be added in the channel.	Land use agencies, project proponents, flood control agencies
SRMP area	**MG3**	Buildings, other structures, and parking areas associated with new off-channel marinas shall not be located on levees or within the minimum setback standards established by Reclamation Board regulations. Marina site layout should maintain and improve the continuity of and safe passage on levee roads and other public or private right of ways.	Land use agencies, project proponents, flood control agencies
SRMP area	**MG4**	Connect the marina directly to the river at both the upstream and downstream ends, enabling fish escapement and reducing the attraction of out-migrating juvenile salmonids into off-channel embayments where they are exposed to greater predation, delayed out-migration, and lower water quality.	Land use agencies, project proponents, flood control agencies
SRMP area	**MG5**	Avoid removal of shoreline trees or excavation and fill of near-shore, shallow water habitat. As part of the marina grading and development site layout, create new shallow water and floodplain habitat alongside the channel margin. Excavate a new, low floodplain with native plantings on lower channel banks that creates a band of vegetated floodplain inundation zones used by juvenile fish in the months of December through March.	Land use agencies, project proponents, flood control agencies

Guidelines for New Bridges (SRMP Area)

Bridge design typically includes hydraulic analysis to set key design elevations and dimensions, assess potential hydraulic impacts, and minimize the need for or extent of scour protection around bridge piers and abutments. Bridges typically

are subject to detailed regulations (in addition to Reclamation Board Title 23 regulations) and standards that include hydraulic criteria. Some or all of the following new bridges (NB) guidelines are therefore likely to be implemented in the normal course of bridge design:

Location	Guideline		Responsibility
SRMP area	**NB1**	Unless set higher for navigation purposes, initial design parameters for SRMP bridges are to set the lowest structural member 1.0 foot above the levee-top elevations, or 6 feet above the design water surface profile, whichever is higher.	Land use agencies, project proponents, flood control agencies
SRMP area	**NB2**	Use no more than two intermediate piers.	Land use agencies, project proponents, flood control agencies
SRMP area	**NB3**	Place the abutments at or near the existing top of bank or levee alignment and avoid encroachment into the flow area below the design water surface elevation.	Land use agencies, project proponents, flood control agencies
SRMP area	**NB4**	Align piers with the flow and design pier shapes to shed debris. Avoid use of scour protection techniques that encroach into the flow or that can potentially trap debris.	Land use agencies, project proponents, flood control agencies
SRMP area	**NB5**	Use pier layouts consistent with existing navigation patterns established by bridges and other structures upstream and downstream. Maintain the center of the channel free of piers, with a minimum clear width equivalent to 50% of total channel width as determined under typical summer flow conditions.	Land use agencies, project proponents, flood control agencies
SRMP area	**NB6**	Allow bank vegetation in the vicinity of bridges to the extent that it does not interfere with normal maintenance and inspection, but within 100 feet of bridges plant and maintain vegetation to limit it to only those species that reach normal height of no more than 20 feet at maturity.	Land use agencies, project proponents, flood control agencies
SRMP area	**NB7**	Provide clearance for maintenance and inspection vehicle access under the ends of bridges and provide larger flood-fight equipment (e.g., rock-hauling trucks) access from the levee top under or over the ends of bridges or along the landside levee toe. Ramps on the downstream side of the bridge may face upstream to meet this requirement.	Land use agencies, project proponents, flood control agencies
SRMP area	**NB8**	Provide provisions for emergency closure of bridges during flood events.	Land use agencies, project proponents, flood control agencies
SRMP area	**NB9**	Conduct periodic scour, debris, and structural inspections; maintain inspection records; and provide records to the Reclamation Board on request.	Land use agencies, project proponents, flood control agencies

Guidelines for Fishing Piers (SRMP Area)

The guidelines for fishing piers (FP) are:

Location	Guideline		Responsibility
SRMP area	**FP1**	Maximize use of existing unused structures for fishing piers, where their design conforms to basic hydraulic criteria to minimize impacts on conveyance and debris and they are structurally sound.	Land use agencies, project proponents, flood control agencies
SRMP area	**FP2**	Provide improved parking and access facilities for shore fishing. Parking areas should be on adjacent city streets or parking structures on the dry side of the levee or floodwall, or on waterside levee berms with suitable width and height above the river water surface under normal circumstances. Parking on levee roads should not be allowed unless the parking lane is in addition to the minimum-specified crown width.	Land use agencies, project proponents, flood control agencies

Habitat Conservation Guidelines

The role of Habitat Conservation Guidelines in the FMP is to conserve and enhance the natural character of a living river ecosystem, and its associated habitats, in the context of an urbanizing waterfront and an important regional floodway confined within a levee system. These guidelines seek to achieve a **balance** among a safe and efficient floodway, urban waterfront development, and a natural riparian corridor flanking a living river ecosystem.

The overarching vision of the Habitat Conservation element is to establish guidelines that promote the "greening" of the river corridor, while protecting existing riparian vegetation and aquatic habitats. This will be accomplished by a creative, multi-fronted approach to habitat infill projects that close the barren gaps in the continuity of riparian and shoreline aquatic habitat. The primary emphasis of habitat infill is the reestablishment of native vegetation along the water's edge. Equally important but lesser opportunities exist on remaining, low floodplain surfaces inside the levees (*berms*, in the vernacular of flood managers) subject to periodic inundation. Seasonal inundation cycles of riparian forest and moist meadow vegetation is a natural, annual process considered essential to many river ecosystem functions and aquatic habitat quality.

Revegetation can take many forms, including native trees, shrubs, or flood-tolerant sedges and grasses. Where public greenways and trails are situated on the tops of banks and levees, even nonnative shade trees and ornamental shrubs and grasses contribute to food availability, cover, and increased habitat quality and size. Site constraints should determine which forms or combinations thereof are most appropriate, but the overall goal is to incrementally expand the continuity of the river "greenway" with native vegetation as a priority to create native habitats for fish and wildlife.

The emphasis on revegetating the lower banks of the river is compatible with recognized, irreversible constraints of a levee-confined floodway. New vegetation cannot be allowed on the upper banks of levees, except on oversized levees, because of an uncontested need to avoid added risk factors to the stability and reliability of the levee system. Woody or herbaceous vegetation at the shoreline and lower one-third of riverbanks contributes to the stability of banks and levees, has little or no effect on floodway capacity, and does not redirect hydraulic impacts. Its presence and expansion will also contribute significantly to the visual quality of the river, provide cooling shade in hot summers, and soften the hard edges of the urban built environment.

Another purpose of the habitat conservation guidelines is to establish new and more enlightened, region-wide approaches to the routine removal of natural vegetation flanking the river. Periodic removal, burning, and herbicide application is a typical component of current levee and floodway maintenance procedures, although the methods and extent vary greatly among reclamation districts and municipal or state maintaining entities. Existing habitat provides food, cover, and nesting habitat for a host of native fish and wildlife species. The timing of removal of this habitat for development, bank protection, or maintenance should carefully consider the life cycle of these species to avoid unnecessary impacts. Consultation with state and federal regulatory agencies before removing riparian vegetation, or working in or near the water, is not only appropriate, it may be required by state and federal regulations.

Hydraulic modeling analysis (MBK Engineers 2005, Appendix E) prepared for the Forum has established that the hydraulic effect of shoreline vegetation in this reach of the Sacramento River appears to be insignificant.

Older riparian trees and shrubs growing in the face of river and levee banks only pose a risk to levee stability where woody species are rooted in the mid to upper banks that coincide with the constructed levee section. In fact, low bank vegetation plays a significant levee protection role by binding weak soils, reducing floodflow velocity near the banks, and effectively attenuating boat wake and wind wave energy that would otherwise nibble away at the lower banks where vegetation is not present. In some cases, the few remaining groves of mature riparian habitat can be conserved by widening or reinforcing levees on the landside, or with local levee setbacks, to avoid the necessity of removing vegetation growing on the mid to upper banks of the levee section.

A final but equally important role of the guidelines is to establish the interdependency, and find ways to link the ongoing protection, of riverbanks that threaten levee stability with the need for habitat conservation and expansion in the corridor. New bank protection can be designed to consistently incorporate shoreline plantings, and in some cases submerged woody material for fish habitat. Mitigation projects along the river can and will offer similar improvements to river habitats. In fact, future bank protection and its mitigation projects are likely to represent the primary source of funding and construction of new habitat along the Sacramento River and for the conservation of remaining waterside berms supporting old growth riparian forest.

The guidelines for habitat conservation (HC) are:

Location	Guideline		Responsibility
Entire corridor	**HC1**	Take all appropriate steps to halt the progressive loss of natural banks and remaining waterside berms. Proactive measures need to address the causes of landform depletion, primarily from erosion of riverbanks and bed.	Flood control agencies and natural resource agencies
Entire corridor	**HC2**	Initiate an ongoing program to plant native riparian vegetation on remaining, unvegetated waterside berms. Where feasible, excavate or construct low floodplain surfaces, waterside of the levees, that can be frequently inundated in winter and spring to provide shallow water refuge for juvenile salmonids. Consideration should be given to dredging adjacent flood channels to accumulate the materials needed to construct these waterside berms.	Natural resource, land use, and flood control agencies
Entire corridor	**HC3**	Establish trees, shrubs, or herbaceous cover on most of the unvegetated, low-flow shoreline, up to the height of the levee foundation grade (approximately one-third bank height).	Natural resource, land use, and flood control agencies
Entire corridor	**HC4**	Incorporate woody and herbaceous riparian plantings into the design of all future bank stabilization projects.	Flood control agencies and natural resource agencies
Entire corridor	**HC5**	Allow the judicious placement of fine- and medium-textured woody material in rocked and natural banks of the river, anchored at the toe of the low bank shoreline where it benefits fish the most. Allow trees and shrubs that have fallen into the channel through natural processes to remain as fish habitat, wherever such conditions do not contribute to the risk of ongoing bank erosion near the levees.	Flood control agencies and natural resource agencies
Entire corridor	**HC6**	Allow narrow plantings of fine- and medium-textured woody or herbaceous plants on the shoreline and lower bank of existing rocked and natural banks along the river (i.e., restore the continuity of shaded, shallow-water aquatic habitat and riparian forest continuity.	Flood control agencies and natural resource agencies
Entire corridor	**HC7**	Ensure the diversity of fish and wildlife species and food web productivity by promoting planting and mitigation projects that favor native riparian plants and include numerous plant species appropriate to the river margins.	Natural resource agencies
Entire corridor	**HC8**	Survey, document, and conserve the locations and quality of large, existing habitat nodes along the river corridor on both sides of the levee system.	Natural resource agencies
Entire corridor	**HC9**	Encourage establishment of new, large habitat nodes on the riverside berm of future levee setback projects and on the adjoining landside of the levees. Mitigation projects for urban infill effects on upland species (e.g., Swainson's hawk, valley elderberry longhorn beetle, and giant garter snake) can be located along the river bordering levees to contribute to large habitat nodes and habitat connectivity.	Flood control agencies and natural resource agencies

Location	Guideline		Responsibility
Entire corridor	**HC10**	Promote land acquisition and conservation easements that allow for or protect existing habitat nodes and mature riparian forest adjacent to the river.	Natural resource and land use agencies
Entire corridor	**HC11**	Modify bank vegetation management procedures to allow the preservation of existing habitat nodes and riparian vegetation on riverbanks. Evaluate and reconsider whether traditional channel vegetation management and removal practices on the lower bank slopes and shoreline are necessary in light of the results of 2-D hydraulic modeling completed for this FMP.	Flood control agencies and natural resource agencies
Entire corridor	**HC12**	Initiate and promote ongoing pilot projects that combine engineered hard features with bioengineering and low-bank vegetation to stabilize eroding banks and to reduce the chronic problem of boat wake energy attacking the banks and causing incremental bank retreat.	Flood control agencies and natural resource agencies
Entire corridor	**HC13**	Support and encourage integrated, biotechnical design of future bank protection and mitigation projects by local, state, and federal flood control agencies.	Flood control agencies and natural resource agencies
Entire corridor	**HC14**	Future projects on riverside land and banks should include measures to eradicate or suppress invasive, exotic plants as part of the project description where the presence of these nonnative species diminishes habitat quality or contributes to bank or levee instability.	Natural resource, land use, and flood control agencies and project proponents
Entire corridor	**HC15**	Improve fire suppression and limit the extent of wildfires caused by careless acts that destroy native vegetation, and improve the response time and priorities of local fire departments. Wildfires on rivers are typically followed by major and persistent infestations of invasive weeds.	Land use and fire control agencies
Entire corridor	**HC17**	Minimize the extent and effects of urban projects that occupy or diminish the habitat value of remaining berms and low bank surfaces where riverine habitats thrive best.	Land use agencies
Entire corridor	**HC18**	Support and use the new Standard Assessment Methodology (SAM) proposed for use by the Interagency Working Group (IWG) of the SRBPP to fairly and quantitatively assess both existing, preproject conditions and proposed mitigation project values. SAM is also designed to optimize the habitat designs and quality of mitigation projects for threatened and endangered fish species (e.g., salmon, steelhead, delta smelt).	Forum
Entire corridor	**HC19**	Increase the coordination with and participation of the SRBPP's IWG member resource agencies in the Forum process and future agreements related to the FMP guidelines and implementation.	Forum
Entire corridor	**HC20**	Treat the river as a joint commitment to an ongoing process of river restoration, in which mitigation of bank protection projects offers a major source of funding and implementation.	Forum
Entire corridor	**HC21**	Integrate bank protection with fish and wildlife habitat conservation, and prioritize construction of these projects to protect remaining waterside berms. Berms offer an added level of security to levees and support some of the most important mature riparian forest and fish habitat along the river corridor.	Flood control agencies and natural resource agencies

Location	Guideline		Responsibility
Entire corridor	**HC22**	Seek additional sources of funding for riverside habitat creation and enhancement by initiating partnerships of local agencies with the CALFED Program's annual Ecosystem Restoration Program grants. Funding success is best achieved through the development of regional river conservation plans and projects supported by a broad coalition of local stakeholders and public agencies.	Forum

Figure 18 illustrates the general floodway vegetation zones in the corridor and presents ideas for the types of plants that could be used to revegetate the banks in each zone. Appendix C contains complete revegetation concepts for various common bank conditions along the corridor.

Guidelines for Bank Vegetation (SRMP Area)

In addition to the previous Habitat Conservation Guidelines, the following guidelines are targeted specifically toward the SRMP portion of the study area. While they may also be applicable to the entire study area, they were created specifically to address the numerous projects proposed in the SRMP.

A significant fraction of the SRMP project area has bank protection that has eliminated, altered, or suppressed vegetation on the banks. Revegetation therefore requires consideration of modifications to existing bank protection, which in some areas appears to be randomly constructed with low-grade materials and substandard reliability for bank stabilization (e.g., broken concrete rubble, bricks, and other construction debris).

Projects consistent with the SRMP that propose to remove or modify segments of existing bank protection need to address the potential effects on levee stability and bank erosion rates. In general, project-specific technical analyses must establish that overall project effects are consistent with the existing level of bank and levee stability, or improve local bank conditions where stability is questionable.

In addition to bank protection, human activity and uncontrolled access along the river have damaged riparian vegetation in some areas. Implementation of the SRMP will generate additional use of the riparian area, which has potentially damaging effects on native vegetation. These potential effects can be offset by a combination of controlled, convenient access to the river and education of visitors regarding the importance and ecological functions of the riparian area. Revegetation is therefore strongly linked with the public trail and open space elements of the SRMP, including the modifications to topography or levee alignment that are necessary in some areas to construct a trail.

The following guidelines for bank vegetation (BV) apply to the treatment of bank vegetation in the SRMP planning reach, in some cases associated with needed bank stabilization measures. However, their application within the SRMP should

be consistent with the guidelines as a whole and not inconsistent with floodway functions. Illustrations of conceptual bank stabilization treatments on actual river cross sections with habitat features integrated into the design are shown in Appendix C. See also Figure 18 for appropriate plant species tolerant of a range of vertical flood zones.

Location	Guideline		Responsibility
SRMP area	**BV1**	Where existing rock revetment is stable, consider addition of imported soil to the rock blanket and inter-planting of rock voids with native (indigenous) riparian trees and shrubs.	Natural resource, land use, and flood control agencies and project proponents
SRMP area	**BV2**	Where stable lower slopes are present but have bare areas, plant native riparian trees and shrubs to fill in bare patches.	Natural resource, land use, and flood control agencies and project proponents
SRMP area	**BV3**	On relatively stable but barren lower slopes, or on beach sand deposits that are more or less continuous along the summer low-flow shoreline, plant in a narrow but dense line along the shore. The design principle is to plant in a narrow row at the base of the slope so that bank and levee inspections are not compromised and to plant the row densely to optimize the root-induced cohesion of sandy substrate. A dense row of vegetation along the shoreline also effectively dissipates boat wake energy and near-bank flow velocity, further contributing to bank stability, habitat quality, and visual enhancement of steep banks.	Natural resource, land use, and flood control agencies and project proponents
SRMP area	**BV4**	Where rock or rubble revetments are in a condition that precludes inter-planting existing voids, remove rings or bands of the revetment to allow planting and subsequently replace the revetment using salvaged or new, larger material.	Natural resource, land use, and flood control agencies and project proponents
SRMP area	**BV5**	In highly developed urban hardscape settings, consider using staggered planting/retaining structures spaced at intervals of approximately 50 feet along the top of levees where trails will be co-located with the levee access road. Trees growing in the planting structures would provide shade for the trail, and the retaining structure would provide a widened flat area along the trail for pedestrians to step off the main trail. In general, follow the design principle that shade trees and planters along public trails shall not conflict with levee maintenance or obstruct access to inspection and repair vehicles and equipment.	Natural resource, land use, and flood control agencies and project proponents
SRMP area	**BV6**	Where new stabilization of the waterside toe of the bank is desired to protect upper bank facilities specified in the SRMP, or in other locations where bank armor becomes necessary to protect levee slopes, plant native riparian trees and shrubs along the lower slope and around bank protection features.	Natural resource, land use, and flood control agencies and project proponents

Location	Guideline		Responsibility
SRMP area	**BV7**	Trees, shrubs, and vines shall not be planted or allowed to establish naturally on levee tops or upper levee slopes unless root masses are confined by suitable containers or retaining walls, or they are planted in oversize levee slopes as specifically discussed in Title 23. The planting design principle is to prevent thirsty roots from elongation within the levee cross section, which could result in levee seepage paths or levee instability from trees that blow down during storms, thereby exposing large, upturned root wads and unprotected bank soil.	Natural resource, land use, and flood control agencies and project proponents
SRMP area	**BV8**	Existing native riparian trees and shrubs should be preserved and remain undisturbed as projects are phased in, consistent with the SRMP, especially large shade trees and vegetation overhanging the river or growing on lower slopes and shorelines. Streamside trees and shrubs provide shade and visual interest for people, and also act to stabilize sandy slopes, reduce near-bank flow velocity, dissipate wave and boat wake energy, and provide critical habitat for aquatic life and riparian-dependent terrestrial wildlife species.	Natural resource, land use, and flood control agencies and project proponents
SRMP area	**BV9**	Bank vegetation planting features and bank protection measures need to be integrated into the implementation design phase of the SRMP. River corridor trees are an important element and essential public amenity of the SRMP (e.g., shade and viewsheds), but their inclusion within the floodway corridor needs to be consistent with other guidelines to be successful and compatible with floodway functions.	Natural resource, land use, and flood control agencies and project proponents

Section 4

DRAFT Implementation Strategies

This FMP and its recommended guidelines remain only the advisory work of an informal collaborative group until such time as public agencies with decision-making authority take steps to approve or adopt specific recommendations. This section presents implementation strategies that will help further the goals of the FMP by putting the guidelines into practice. The implementation strategies are presented in two groups. The first group of implementation strategies consists of "near-term actions," considered to be tangible actions that some agencies have agreed to undertake in order to help test the guidelines in practice while improving the management of key aspects of the river corridor. The second group of implementation strategies consists of "long-term needs" that agencies should consider supporting, approving, and/or initiating in order to increase the body of knowledge and improve the ability to apply the guidelines in ways that will further benefit the corridor.

First among the near-term actions and fundamental to the implementation strategies as a whole is the continuance of the Forum itself so that the members can turn their attention to building the partnerships and collaborations needed for implementation and action. The Forum is a voluntary association without legal status or authority. Its continuance will depend on the ongoing support of Forum participants in the form of assigned staff time and financing for meeting facilitation and technical support services. Local agency support will not be forthcoming unless continuance of the Forum and use of the guidelines enable the participants to advance their interests in ways that would not be possible without the Forum. Simply put, the Forum and the guidelines must demonstrate their value, or they will be abandoned.

Near-Term Actions

1. Continuance of Forum

The MOU signatory agencies should renew their commitment to maintaining the Forum as a vehicle for supporting implementation of the guidelines, reviewing proposed projects for consistency with the guidelines, and promoting the kind of interagency cooperation that is necessary to improve floodway management, reduce the uncertainties and delays associated with riverfront development, enhance river-dependent habitat values, and increase public access to the river.

This commitment should include appropriate arrangements for securing the financial and agency staffing support needed to maintain the Forum.

2. Maintenance of Hydraulic Model

SAFCA should maintain the modified 1-D UNET model (or approved HEC-RAS successor) as the standard tool for analysis of project effects in the Forum's 50-mile reach of the Sacramento River, using the 1997 Flood and Maximum Flow scenarios. With the concurrence and support of DWR, the Reclamation Board, and the Corps, SAFCA should make periodic updates and maintain the model to reflect technical corrections, new information, and significant changes in the floodway. The complete model and a simplified version for the Forum planning area should be available for use by all agencies, subject to guidance on appropriate use of modeling methods and assumptions for input parameters. Substantial in-channel, future projects that require 2-D modeling (two-dimensional simulations) should use the 1-D model assumptions, baseline conditions, and flood scenarios as input to the 2-D model runs that are necessary to assess potential local hydraulic effects.

Consistent with keeping the model updated, monitoring of large flood events to collect data for hydraulic model calibration and evaluation of bank and bed stability should be carried out. For events with stages greater than 25 feet at the I Street gage, measure and record high-water marks and conduct post-flood inspections to identify erosion sites and debris accumulations and to check the integrity of floating structures and access facilities. Similarly, conduct channel surveys on 10-year or shorter intervals to update model bathymetry and monitor changes in bed elevations.

3. SRMP Projects Brought Forward by Cities

The cities of Sacramento and West Sacramento should continue to rely on the Forum for review of specific projects that further the implementation of the 2003 SRMP. Sacramento's Docks Area Specific Plan, currently under development, is incorporating several of the guidelines into design and site-planning features. The city should seek some degree of formal recognition of these guidelines through the project California Environmental Quality Act (CEQA) environmental documentation and through the permitting process of the Reclamation Board. The City of West Sacramento is bringing forward projects requiring similar agency review and intends to apply for permits to rebuild the Raley's Landing dock and extend the riverfront promenade improvements south of Tower Bridge. These first phase SRMP projects on both sides of the river should incorporate the guidelines into the respective project descriptions, and seek recognition of them through the Reclamation Board's permitting process. Successful environmental review and permit approval of these projects should help to solidify the value of the Forum and FMP guidelines. A successful outcome for these initial SRMP projects will validate the guidelines as vehicles for reducing uncertainties and expediting construction in a manner that will promote riverfront development while enhancing floodway safety and reliability, improving river-dependent habitat values, and providing appropriate river access opportunities.

4. East Bank Corridor Management Plan

SAFCA is currently developing a comprehensive bank protection and channel maintenance program for the east bank of the Sacramento River that will have as equal objectives: improving the reliability of the flood control system and enhancing river-dependent habitat values. To be successful, this program will need the support and cooperation of many federal and state flood and environmental resource managers. SAFCA should use the Forum to refine project objectives, work out details of program measures in a manner consistent with the guidelines, and seek the broad support and cooperation necessary for its implementation.

5. Legislation Affecting the SRFCP

DWR is currently working with the Legislature to address state liability issues growing out of the recent Paterno decision. Among the topics that could be addressed in legislation over the next 2 years are:

- clarifying the scope, purpose, and management requirements of the SRFCP;
- intensifying the state's floodplain mapping program;
- ensuring that property owners in SRFCP-protected floodplains are regularly and accurately notified of the risk of flooding;
- promoting flood insurance as an integral part of the state's flood risk management program;
- clarifying the factors to be considered in determining state and local governmental liability for inverse condemnation damages in flood cases;
- developing new financing mechanisms for maintaining and improving SRFCP levees; and
- incorporating flood risk management more directly into the local land use planning process.

The Forum should serve as a venue for affected interests to be informed on these legislative topics and help shape the substance of legislation. The Forum could review and provide regional input to legislative initiatives such as a proposal to include flood control in the General Plan Update requirements for cities and counties; new mechanisms to meet the financing needs of rural/regional flood control structures; consideration of possible new standards for urban and rural/regional levees; ways of informing the public of the risks of moving into subdivisions constructed in agricultural areas; and a potential statewide insurance plan to manage flood risk.

6. Structures in the Floodway

The Forum should be used by the City of Sacramento and the City of West Sacramento to develop, in consultation with flood protection and resource agencies, recommendations for construction guidelines, ordinances, and code

requirements using best current practices and engineering analysis for the design and construction of safe structures in the floodway. These requirements should address the following public safety concerns:

- unobstructed, continuous levee access for flood control and emergency vehicles and equipment;
- reliable anchorage of floating structures in the channel bed or on banks and levees;
- effective deflection of floating debris;
- automatic shutdown of utility connections with centralized shutdown switches or valves on in-channel structures in the event of a flood emergency;
- occupancy requirements and other operating criteria during major flood events or flood damage repairs, including temporary closure of riverside structures when appropriate;
- periodic inspections of in-channel structures, associated sediment deposition or scour, access ramps, and anchoring and dewatering systems; and
- other structural, building, flood protection, and navigation safety issues.

7. Levee Protection

The Forum should serve as an interagency support system to assist with implementation of the Levee Protection Area guidelines and with broader public education about the potential risks of seepage effects on levees and the spatial requirements of future flood fighting and landside levee repairs.

Long-Term Needs

1. Incorporation of Guidelines into City and County General and Community Plans

Some of the MOU signatory agencies are currently updating their general plans, initiating specific area plans, or otherwise reviewing planning policy activities in the Sacramento River corridor. In some cases, current planning policies may be inconsistent with the guidelines or may not address or incorporate important measures and recommended policies contained in the guidelines for meeting the Forum's goals and objectives. Land use and planning agencies should use the Forum to develop appropriate policy and planning changes consistent with the guidelines.

2. Improved Bank Protection and Levee Stability

- Flood management and local levee maintenance agencies should review existing fees, budgets, required revenues, and maintenance jurisdictions.

They should develop a financing and implementation plan to match funding with required revenues, considering potential for shared resources and consolidation of maintenance jurisdictions.

- The Forum should create a task group to develop an information center for the Sacramento River in the planning reach. The information center may be managed by one or more of the existing flood management and levee maintenance agencies. The group should consider the feasibility of disseminating information in multiple ways, including a web-based information center, with links to member agency websites.
- Forum members should create a working group of resource, flood management, and levee maintenance agencies and community and environmental groups to produce and implement an MOU or other adopted document that defines feasible avoidance criteria, establishes thresholds for permits, and defines a streamlined process for environmental compliance for levee maintenance and minor repairs. The panel also should define mitigation requirements for minor, but unavoidable, impacts associated with routine activities and thresholds for project-specific consultation on more complex mitigation. The panel should consider designating potential mitigation sites or activities by reach or region, so that mitigation of minor impacts can be implemented as the need occurs, without additional design or land acquisition. The MOU should be adopted by levee maintenance entities and the essential resource and permitting agencies.
- Forum members should encourage and support efforts by the state Reclamation Board and DWR to modernize and streamline both code enforcement and awareness programs regarding floodway and levee regulations.

3. Good Access to Levee Roads

- In areas where existing roads are on levee crowns and new development is not planned, the Forum should create a panel to review with the California Department of Transportation (Caltrans) the impacts of state highways on levee maintenance, inspection, flood fighting, and public access and to seek potential solutions to the problems through collaborative action.
- Forum members should initiate with Caltrans a collaborative review of existing and future transportation corridors using levee tops. The purpose of the review will be to determine where and when levee roadways can be relocated off the levee, or where levees can be widened or modified to safely accommodate future road use for a combination of transportation, flood control, and public access purposes.

4. Public Access

- Forum members should initiate a regional public access/recreation planning effort to further define public access/recreation needs, opportunities for increasing continuity, and implementation/funding strategies. The general framework for this effort should include identifying and categorizing existing

facilities and their usage (including informal access points), determining access needs, considering the various types of access (physical, visual, etc.), considering what constitutes "good" access (safe, available parking, desirable location, etc.), and ultimately modifying existing access points/facilities or developing new ones in a manner that furthers the overall goal to increase public access while meeting local and regional needs.

- The regional public access/recreation planning effort mentioned above should lay the groundwork for identifying funding sources or developing a funding program. Efforts should focus on identifying actions that benefit multiple agencies/interests, thereby producing multiple funding sources. A multi-jurisdictional approach would greatly enhance the ability to attract state and federal funds to study this issue, develop a comprehensive plan, and obtain funding for plan implementation.

5. Habitat Conservation

- Seek additional sources of funding for riverside habitat creation and enhancement by initiating partnerships of local agencies with the CALFED Program's annual Ecosystem Restoration Program grants. Funding success is best achieved through the development of regional river conservation plans and projects supported by a broad coalition of local stakeholders and public agencies.
- Convene a Forum working group of resource agencies, local and state flood control maintaining agencies and districts, bank protection design engineers, and river restorationists focused on the Forum's Sacramento River study area. The purpose of the cross-profession, multi-agency dialogue is to establish new protocols for the management of river vegetation and instream woody material, and for the design of bank protection projects and levee maintenance measures that successfully integrate habitat conservation objectives with public safety and legal obligations.